Final Report

Grants Pass Stormwater Facilities Master Plan

Prepared for

City of Grants Pass

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Executive Summary

The overall goal of the Grants Pass Stormwater Facilities Master Plan (SWFMP) is to recommend a series of improvements to the City's storm drain system that manage the quantity and quality of stormwater runoff under current and future development conditions. In 1982, the City developed a city-wide drainage master plan to help guide expansion of the system to serve current and future development within the Urban Growth Boundary (UGB). While this plan has been a useful tool, development has outpaced the recommended improvements and an update is now necessary. In addition, issues such as stormwater quality and the associated regulatory implications have also reinforced the need for a revised master plan.

The goal of this stormwater facilities master plan is to manage stormwater runoff to protect water quality and aquatic habitat and to minimize impacts of development on localized and downstream flooding by identifying infrastructure improvements to the collection, conveyance and treatment of stormwater runoff within the Grants Pass Urban Growth Boundary.

Basis of the Plan

The following goals, principles and policies provide direction for stormwater management strategies and practices. These were then implemented by establishing technical criteria and data contained in the SWFMP.

1. Provide protection from periodic inundation which could result in loss of life and property.
2. Protect and enhance natural resources associated with the stream environment.
3. Prevent significant erosion resulting from stormwater runoff and adverse effects on water quality.
4. Assure an orderly extension of the storm drainage system to serve existing and future development.
5. Provide a regional approach to stormwater management which is consistent with other community goals and plans.

Analysis Approach

A hydrologic, hydraulic and water quality analysis of the study area was performed to estimate peak flow rates, runoff volumes and pollutant loads of for existing and future land use conditions. These estimates were then used to determine the existing and required capacity of the cities stormwater infrastructure and to size new facilities where the system is, or will be, under capacity.

In addition to evaluating the stormwater runoff from the future land use scenario as identified is the City's Comprehensive Plan, a low impact development condition was also considered. Low impact development practices represent an on-site (i.e. parcel by parcel) stormwater management approach that manages runoff at the source using small-scale stormwater facilities and best management practices (BMPs). The goal of low impact development practices is to mimic a site's predevelopment hydrology by using techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Consequently, as the level of low impact development practices increase within the basin, the need and size of large regional stormwater management systems or improvements decreases. To address the affect low impact development practices will have on stormwater runoff, it was assumed that the new impervious area for all new and redeveloping parcels would be managed with flow control and water quality measures.

System Deficiencies

System deficiencies can be categorized as either water quantity or water quality related. Water quantity, or hydraulic, deficiencies are generally related to an undersized or poorly designed conveyance system. However, hydraulic deficiencies can also result from insufficient system storage or excessive runoff generated from highly impervious land cover. In addition to hydraulic deficiencies, areas with excessive pollutant concentrations and/or loads also can be classified as deficient from a water quality perspective.

To identify deficiencies for both categories, results from the system analysis were evaluated against the following criteria for each land use scenario:

- *Storm Drain Surcharging*: Surcharge conditions for the piped system are acceptable only for demonstrating the adequacy of the conveyance system to convey the peak runoff for the 25-year storm, provided that the hydraulic grade line (HGL) is 2-feet lower than the manhole rim elevation.
- *Channel Flooding*: Natural channel reaches were added to the problem identification list if the 25-year design storm causes the channel to overtop its bank.
- *Culvert Crossings*: During the 25-year design storm, culverts at locations where the hydraulic analysis predicts that the HGL would inundate the road sub-grade were classified as undersized.
- *Water Quality Areas of Concern*: The presence of "hot spots" indicates elevated pollutant loads and concentrations as compared to other areas within the city. These areas, as well as any area exceeding local water quality standards, were added to the problem identification list.

Alternative Analysis and Recommendations

A set of alternatives were developed for each of the system deficiency identified in the system analysis. Each alternative can generally be described as either conveyance-oriented, water quality oriented, or as a dual-purpose facility. Conveyance alternatives include new or upsized storm drain pipes, enlarged culverts, improved channels or canals, flow diversions and detention ponds. Water quality improvements included ponds, channel enhancements and structural pollution reduction facilities. Structural pollution reduction facilities are considered water quality manholes and vaults using filtration and/or hydrodynamic separation as the pollutant removal mechanism. They can be proprietary or non-proprietary in design.

A number of alternatives were evaluated for each problem area to arrive at a recommended or preferred alternative. In some cases several alternatives resulted in a viable and constructible solution; however, the goal of improving system conveyance and water quality in a single facility typically became the deciding factor during the alternative selection process. The following section describes the results of this analysis for each of the major drainage basin within the City.

Sand Creek Basin

The recommended plan includes 15 individual CIP projects. Collectively, the improvements include three new detention/water quality ponds, one retrofitted water quality pond, three structural pollution reduction facilities, three new culverts, and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over seven millions dollars, which includes all construction activities, mitigation and land acquisition, with the exception of mitigation land acquisition and maintenance. From an implementation standpoint, a majority of the projects are located in public right-of-way, although in several cases, coordination with the County and ODOT may be required. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

Gilbert Creek Basin

The recommended plan for the Gilbert Creek basin includes 23 individual CIP projects. Collectively, the improvements include one large regional detention/water quality facility, two smaller detention/water quality ponds, seven structural pollution reduction facilities, one channel capacity expansion project, and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just under 13.0 millions dollars, which includes all construction activities, mitigation and land acquisition. From an implementation standpoint, a majority of the projects are located in public right-of-way within the existing city, however a number of new projects are also proposed in the hilly areas surrounding the Blue Gulch area. Additional erosion control will be required for these projects. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

Allen Creek and Fruitdale Creek Basins

The recommended plan for the Allen Creek and Fruitdale Creek basins includes 12 individual CIP projects. Collectively, the improvements include two large regional detention facilities in the upper reaches of each basin, two culvert replacement projects, four structural pollution reduction facilities, one water quality pond, two water quality swales and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over nine millions dollars, which includes all construction activities and land acquisition. From an implementation standpoint, several projects are located in along major roadways (Rogue River Highway, Redwood Highway and Williams Highway) and will likely require coordination with the County and ODOT. Additionally, because ODOT is currently investigating improvements to Redwood Highway, several improvements may be partially or fully funded and constructed by ODOT. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

Skunk Creek and Jones Creek Basins
The recommended plan for the Skunk Creek and Jones Creek basins includes 12 individual CIP projects. Collectively, the improvements include a series of major channel improvements to the Mill Creek drainageway; one detention facility, six structural pollution reduction facilities, one new culvert and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over five millions dollars, which includes all construction activities and land acquisition. From an implementation standpoint, improvements along Skunk Creek and the Mill Street drainageway will require coordination with surrounding property owners and businesses as well as the Southern Oregon & Pacific Railroad. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

Special Consideration: Blue Gulch Area
Given today's regulatory environment and the inherent water quality benefits of surface flow, it is recommended that the channel system within the Blue Gulch area remain open with minimal obstructions such as culvert crossings or exceedingly close development. Future upland developments that will drain to this channel are recommended to use the traditional pipe, pond, water quality BMP approach for stormwater treatment. Additionally, consideration should be given to sediment traps prior to discharge to the channel to reduce maintenance and keep the conveyance and treatment system functioning.

Special Consideration: Irrigation Canals
In addition to the traditional conveyance and water quality improvements within the city, special consideration should be given to the irrigation canals that run east-west through the city. Localized flooding resulting from excessive stormwater runoff was predicted, or has been observed, at various locations along the South Main Canal, the South Highline Canals, the Demaray Canal and the Tokay Canal. Specific improvements are needed for these areas because of their length and because they are likely to require special coordination with the Grants Pass Irrigation District as well as numerous neighboring land owners and possibly ODOT. In addition to these system-wide improvements, more rigorous

maintenance of the canal system is recommended including cleaning, lining, and widening in areas that experience flooding.

Capital Improvement Program

The goal of this plan is to manage stormwater runoff to protect water quality and aquatic habitat and to minimize impacts of development on localized and downstream flooding by identifying infrastructure improvements to the collection, conveyance and treatment of stormwater runoff within the Grants Pass Urban Growth Boundary. To these ends, a set of 62 capital improvement projects were developed. Project costs were estimated for each recommended improvement and a qualitative evaluation defined the relative priority of each project.

Collectively, the plan identifies both large (> $500,000) and small (< $500,000) projects and short-term (0-5 years) and long-term (5+ years) projects. The 3 highest priority large projects are anticipated to cost just under 3 million dollars and include two regional detention ponds and one large storm drain system improvement. The 8 highest priority small projects are anticipated to cost roughly 2.5 million dollars, with at least one high priority small CIP project located in each of the drainage basins.

SECTION 1

Introduction

The overall goal of the Grants Pass Stormwater Facilities Master Plan is to recommend a series of improvements to the City's storm drain system that manage the quantity and quality of stormwater runoff under current and future development conditions. In 1982, the City developed a city-wide drainage master plan to help guide expansion of the system to serve current and future development within the Urban Growth Boundary (UGB). While this plan has been a useful tool, development has outpaced the recommended improvements and an update is now necessary. In addition, issues such as stormwater quality and the associated regulatory implications have also reinforced the need for a revised master plan.

The goal of the Grants Pass Stormwater Facilities Master Plan is to proactively manage stormwater runoff to protect the water quality and aquatic habitat of the receiving waters and to minimize impacts of increased runoff from development within the storm drain conveyance system. These goals are met through the SWFMP by identifying infrastructure and natural resource improvements for the collection, conveyance and treatment of stormwater runoff from the six Grants Pass basins. The plan prioritizes storm drain improvements within the Urban Growth Boundary and provides a 5-year implementation schedule for the construction of the highest priority projects. Lesser priority projects are also identified in order of importance, and are to be implemented as opportunities arise.

Major tasks undertaken in the development of the plan include the following:

- Development of a stormwater infrastructure plan that alleviates current capacity and flooding problems that can also manage additional runoff generated from future development.
- Implementable engineering solutions.
- Recommend improvements that are sustainable from an operations and maintenance perspective.
- Provide site specific project recommendations for conveyance and water quality system improvements.
- Address regulatory standards
- Identify an achievable level of Low Impact Development Practices and provide engineering guidelines from implementation of Low Impact Development Practices.

1.1 Study Area

The City of Grants Pass is located along the middle reaches of the Rogue River in central Josephine County, in Southern Oregon. The study area for the Stormwater Facilities Master Plan encompasses approximately 8,500 acres and includes six major drainage basins within the 2005 Urban Growth Boundary (UGB). The six major drainage basins existing within the study area are Sand Creek, Allen Creek, Fruitdale Creek, Gilbert Creek, Skunk Creek and Jones Creek (Figure 1.1-1).

1.2 Contents of Master Plan

This Master Plan is divided into the following chapters:

Stormwater Management Goals and Policies
This chapter presents the goals, policies and regulatory considerations guiding the Stormwater Facilities Master Plan (SWFMP).

Planning, Analysis and Improvement Design Criteria
This chapter presents the various system analysis criteria used to identify conveyance and water quality problem areas and to evaluate potential improvements.

Study Area Characterization
This chapter presents the study area and basin boundaries, the general topography, the local climatic conditions, the soils and the primary drainage features.

Model Development
This chapter presents the development and calibration of the XP-SWMM model used in the master plan. Included are a description of the XP-SWMM model, the data requirements, the data sources, the model setup and the model calibration. The development of the water quality model is also discussed in this section.

System Analysis
This chapter characterizes the existing and future hydraulic and water quality problem areas that will be used as a baseline for the development of a stormwater CIP program for Grants Pass.

System Improvement Recommendations
The objective of this chapter is to present the alternatives considered to resolve the system deficiencies identified in Chapter 5 and to summarize the recommended solutions. In addition, this chapter summarizes the methods and factors considered in developing and screening the various alternatives.

Capital Improvement Program
This chapter outlines the recommended system improvements; identifies water quality, and flood control projects to be included in the City's CIP; presents estimated project costs; and provides an implementation plan by ranking the relative importance of each CIP project. This chapter also includes the CIP summary sheets that summarize each recommended project.

SECTION 2

Stormwater Management Goals, Policies and Regulations

This chapter presents the goals, policies and regulatory considerations guiding the Stormwater Facilities Master Plan (SWFMP).

2.1 Stormwater Management Goals

The primary goal of the Stormwater Facilities Master Plan (SWFMP) is to recommend a series of improvements to the City's storm drainage system that manage the quantity and quality of storm runoff under current and future development conditions. To achieve this overall goal, a series of policies are needed to shape how the City will manage stormwater quantity and quality within the Urban Growth Boundary (UGB).

This section summarizes the goals and policies that were used to define the stormwater facility master planning approach. There are other policies and goals in the City's overall Stormwater and Open Space Program that complement the stormwater facility planning process but are not integral to achieving the primary goal of the SWFMP. As such, these overarching policies and goals are not included in this summary. For example, managing construction site runoff is a component of the Stormwater and Open Space Program and has a direct impact on stormwater quality but is not included in the scope of the SWFMP.

The goals, principles and policies presented in this section provide direction for stormwater management strategies and practices. These are then implemented by establishing technical criteria and data contained in the SWFMP.

1. Provide protection from periodic inundation which could result in loss of life and property.
2. Protect and enhance natural resources associated with the stream environment.
3. Prevent significant erosion resulting from stormwater runoff and adverse effects on water quality.
4. Assure an orderly extension of the storm drainage system to serve existing and future development.
5. Provide a regional approach to stormwater management which is consistent with other community goals and plans.
6. Maintain existing creeks and tributaries as natural open drainage channels.

2.2 Stormwater Management Policies

Policy 1 – The City will provide an adequate stormwater collection, conveyance and pollution reduction system for existing and future development within the Urban Growth Boundary.

Implementation Measures:

1. Use appropriate land use projections and associated imperviousness values to estimate the future stormwater runoff.
2. Develop cost effective improvements to the existing storm drainage system that result in a continuous drainage system that provides service to the upstream users.
3. Size the storm drainage system to convey a storm event that has a 4% chance of occurring in a given year (25-year design storm).
4. Develop a financing strategy to fund capital projects that improve the storm drainage system. Financing strategies will be in accordance with existing laws, rules and regulations.

Policy 2 – The City will provide adequate conveyance capacity within the storm drainage system to accept stormwater runoff from outside the UGB.

Implementation Measures:

1. The storm drainage system will be designed to convey flows from outside the UGB based on future land use conditions assuming that existing lands will develop to zoned levels and additional densification will occur in rural residential parcels immediately surrounding the UGB to account for Measure 37.
2. The SWFMP will identify maximum peak flow rates the City's system can convey at locations where flows from outside the UGB enter the City's system.

Policy 3 – The City will strive to minimize flooding, stream bank and channel erosion within the stream and open channel storm drainage system by controlling the volume and rate of stormwater runoff from development and redevelopment projects.

1. Infiltrate storm runoff where site conditions allow as a means of reducing post development runoff volumes and associated flow rates.
2. Identify receiving streams/open channel systems that are geomorphically sensitive. Provide detention facilities that account for bankfull, stream stability discharge rates (e.g., limiting the 2-year post development rate to ½ the predevelopment rate).
3. Provide permanent channel erosion protection via structural or vegetative solutions where environmental conditions dictate.

4. Identify the level of flood protection (25-yr or 100-yr design storms) for specific streams or open channel systems through City ordinances and development code.
5. Assess the stream/open channel system capacity and identify under capacity sections. Limit post development flows through local or regional detention facilities if discharge rates exceed downstream channel capacities.
6. Through the SWFMP, identify and implement regional capital projects that provide adequate flood protection.

Policy 4 – The City will strive to protect the quality of water in the storm drainage system and receiving waters, including the Rogue River, to maintain and enhance the environment, quality of life and economic well-being of Grants Pass.

Implementation Measures:

1. Identify and implement regional, post-construction stormwater quality facilities/best management practices that will reduce pollutants from existing impervious areas.
2. Emphasize the use of surface oriented best management practices to manage stormwater quantity and quality in the City's Capital Improvement Plan projects.
3. Emphasize the use of surface oriented best management practices to manage stormwater quantity and quality in private development projects through revisions to City ordinances and the development code.
4. Identify and implement regional, multi-use flood control and stormwater quality facilities that combine stormwater function with public and natural resource enhancements.
5. Identify and implement practical, low impact development practices with new development, as defined in the SWFMP, on a parcel level to mitigate impervious areas and associated pollutants. Modify City ordinances and development code for method of implementation.
6. Maintain all existing creeks and tributaries as natural open drainage channels (refer to the Grants Pass Stormwater Design Criteria Manual and the Grants Pass Open Space Plan for more discussion on this topic).

Policy 5 – The City will maximize the use of existing storm drainage infrastructure and optimize the size of required drainage system improvements.

Implementation Measures:

1. Allow limited surcharging in the existing storm drain piped system to increase capacities. These minimum levels of surcharging will provide a sufficient safety factor as to prevent flooding under the design storm conditions by limiting the hydraulic grade line to be approximately 2-feet below the ground surface.

2. Utilize appropriate analysis and planning tools to evaluate the system capacity and identify system improvements.
3. Identify an achievable level for implementation of low impact development practices for new development that would reduce the size and extent of required improvements to the existing storm drainage system.
4. Collaborate with the development community to manage inter-basin transfers, if caused by development, through analysis of downstream conveyance and treatment capacities.

2.3 Regulatory Considerations

Water quality treatment (i.e., pollutant removal) of stormwater is a relatively new practice, and is primarily a result of multiple regulatory programs. The water quality characteristics of stormwater are variable, and the pollutants found in stormwater do not necessarily equate with the instream and ground water quality standards, which are the driving forces behind stormwater quality management. As a result, developing a stormwater management strategy to minimize stormwater impacts and protect water quality is challenging.

The following discussion provides the framework used in developing the Stormwater Facility Master Plan (SWFMP) as well as overall water quality treatment policy.

2.3.1 Regulations

There are several federal and state laws and regulatory programs that affect stormwater management strategies. The primary goal of these laws is to protect and/or maintain the water quality of surface and ground water. Below is a summary of the primary regulatory drivers that influence stormwater management.

2.3.1.1 Clean Water Act (CWA)

The 1972 Clean Water Act (CWA) set forth the legal framework for surface water protection. The CWA resulted in a series of programs including National Pollutant Discharge Elimination System (NPDES) discharge permits; Section 303(d) listings of impaired water bodies, and Total Maximum Daily Loads (TMDLs) to create watershed based approaches to identify and minimize pollutant loadings. Within the State of Oregon, the Department of Environmental Quality (DEQ) implements the CWA programs listed below on behalf of the Environmental Protection Agency (EPA).

NPDES MS4

In 1987 the CWA was amended to create a comprehensive national program to address storm water discharges from municipalities called Municipal Separate Storm Sewer Systems (MS4s). This program was implemented in two phases. Phase I (1990) included larger municipalities and Phase II (1999) extended coverage of the NPDES stormwater program to small MS4s. Municipalities are “automatically” part of the NPDES Phase II program when the population reaches 50,000 persons with a density of 1,000 persons per square mile. The City is not currently considered a Phase II MS4, but this designation can change as the population increases.

NPDES MS4 program requires the development of a Stormwater Management Program to address stormwater quality and must include the development, implementation, and evaluation of best management practices (BMPs) within the following categories:

- Public Education and Outreach on Stormwater Impacts;
- Public Involvement/Participation;
- Illicit Discharge Detection and Elimination;
- Construction Site Stormwater Runoff Control;
- Post-Construction Stormwater Management for New and Redevelopment;
- Pollution Prevention for Municipal Operations.

Section 303 CWA

Section 303 of the CWA establishes a process to designate beneficial uses of water and establishes water quality standards to protect these uses. Water quality standards are developed by DEQ for a wide range of pollutants, including toxic chemicals, nutrients, and parameters such as dissolved oxygen and pH.

Under Section 303(d), DEQ is required to maintain a list of waterbodies that do not meet one or more of these water quality standards. Once a waterbody is included on the 303(d) List, DEQ develops a Total Maximum Daily Load (TMDL) for each pollutant. The TMDL is an estimate of the waterbody's ability to assimilate pollutants, while still meeting the designated beneficial uses. The end result of the TMDL process is an allocation of pollutant loading (i.e., allowable discharges) to various parties. Point source discharges are issued "waste load allocations" and non-point discharges (i.e., stormwater) are issued load allocations. Load allocations may be issued to a group of management agencies (e.g., Department of Agriculture) for collective implementation. TMDL loads also are reflected in the various NPDES permits (both point and non-point) that regulate discharges.

The Rogue River is listed on the 2002 303(d) List for temperature and bacteria for river reaches within the City limits, and for pH just downstream from the city. A TMDL process to address these parameters is scheduled for development in 2006 and will encompass the streams and land area within the City. As a result it is possible that the City could receive a load allocation for these parameters. It is also possible that additional listings could occur in the future even after the completion of these TMDLs.

2.3.1.2 Endangered Species Act (ESA)

The federal ESA provides protection for plant, fish, and wildlife species listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS). Because urban stormwater management has significant potential to impact the habitat for listed threatened and endangered species, several sections of the ESA provide additional context for the development of a stormwater management strategy.

Specifically, ESA Section 9 prohibits “take” of a listed species, which includes damage to habitat. NMFS recently adopted a definition of harm similar to that of USFWS which included spawning, rearing, and migrating to the list of essential behavioral patterns (64 FR 60727, November 8, 1999). The preamble to the rule states that the following activities could constitute a take:

- Operating or maintaining barriers that prevent or impede migration to or within a listed species’ essential habitat;
- Discharges of pollutants into a listed species’ essential habitat;
- Alteration of streamflows (such as diversion of water) that is likely to impair migration, spawning, or other essential functions;
- Conducting land use activities and earth moving that may increase sediment loads; or
- Construction of bridges, roads, or trails along streams containing critical habitat.

Currently, there are no fish or aquatic species listed under the ESA within the Rogue River basin. However, there are a number of candidate and proposed aquatic based species (e.g., Oregon spotted frog) that could eventually be protected under the ESA. Such listings could influence discharge water quality requirements.

2.3.1.3 Safe Drinking Water Act (SDWA)

The SDWA was established to protect the quality of drinking water in the U.S and is overseen by the EPA. This law focuses on all waters actually or potentially designated for drinking use, whether from above ground or underground sources. In Oregon, the program regulating the injection of surface water or contaminants into the subsurface Underground Injection Control (UIC) has been delegated to the DEQ. Stormwater injection systems (e.g, drywells) are examples of Class V UICs.

The UIC Program provisions include control of certain avenues for pollutants to enter groundwater aquifers, such as injection wells, dry wells, infiltration trenches, or other facilities which infiltrate surface water at a concentrated location to the subsurface. If municipalities opt to use Class V systems to discharge stormwater, they are required to register the Class V system with DEQ, and potentially collect water quality samples. Additionally, there are restrictions or considerations that DEQ can use for approval such as two-year travel times to drinking water wells and the potential for the drywell to receive hazardous materials or runoff.

2.3.1.4 Oregon Anti-Degradation Policy

In addition to the CWA, the State of Oregon DEQ has an administrative rule developed to eliminate the incremental degradation of water quality. This policy is termed the anti-degradation policy and is applicable to all waters. This policy not only requires that beneficial uses be met, but that existing water quality is maintained. This policy will be applied by DEQ in its review and issuance of a MS4 permits. This anti-degradation policy may affect the City if regulated in the future through the NPDES MS4 permit.

2.3.1.5 Other Regulatory and Non-Regulatory Considerations

The regulatory programs previously addressed apply primarily to stormwater discharges. However, there are other components that may affect the overall stormwater management approach. These include land acquisition, other regulatory requirements (e.g., for construction), long term maintenance and Measure 37.

Certain approaches to stormwater management such as creating retention ponds within existing drainages may not be allowed without agency approvals such as Department of State Lands and U.S. Army Corps of Engineers permits for removal and/or fill of material. Retrofitting existing stormwater conveyance systems to provide water quality treatment can also be challenging due to land acquisition constraints and attempting to provide treatment within the hydraulic capacity of the system. Lastly, long-term maintenance of water quality facilities can be challenging for municipalities due to equipment and staff requirements.

Under Measure 37, which was enacted in 2004, private land owners are entitled to receive just compensation when a land use regulation is enacted after the owner or a family member became the owner of the property and if the regulation restricts the use of the property and reduces its fair market value. Although the true impact Measure 37 will have on stormwater is unknown, it is likely to results in new development and increased imperviousness for areas that were previously zoned to not change.

2.3.2 Pollutants of Concern

As mentioned earlier, under section 303(d) of the CWA the Rogue River is designated as being impaired for temperature, pH, and fecal coliform (i.e., bacteria). The pH listing is for between river miles 68.3 to 94.9, downstream from the City; temperature and bacteria listings include river reaches within the City limits. Urban stormwater runoff can contribute to these impairments; however the contribution can also vary by specific basin. Increased temperature is generally a result of removed riparian canopies, water/channel alterations (i.e., low flows), and dams or diversion structures that increase water residence time. However, a reduction in groundwater recharge and lower stream base flows is attributed to stormwater collection and conveyance.

Acidic or basic pH's are generally attributed to industrial point-source discharges, algal growth, or the use of salts for de-icing. If the pH changes are linked to algal growth, then DEQ may regulate phosphorus in stormwater runoff as excess phosphorus can encourage algal growth.

Bacteria are found in urban stormwater runoff. Animal and pet wastes can contribute to high amounts of bacteria in urban stormwater. Specific water quality treatment measures (e.g., large extended wet ponds) can also increase bacteria counts by attracting wildlife. However, the larger contributing factors are typically considered failing septic systems, leaking sanitary infrastructure, and cross connections.

To date, pollutants typically associated with urban stormwater include total suspended solids, turbidity, heavy metals (e.g., lead, copper), oils and grease, and fertilizers (e.g., phosphorus). DEQ has “set standards” for toxics (i.e., metals, chemicals), sedimentation (i.e., total suspended solids), nutrients, and turbidity. The turbidity standard is currently being revised. Additionally, some pollutants (e.g., phosphorus) are regulated by DEQ as surrogates to address other standards. For example, there is a water quality standard for chlorophyll a, which was developed to protect aquatic life. Increased chlorophyll a is considered to be a result of increased phosphorus loading to waters that then promotes aquatic growth. Therefore DEQ will regulate phosphorus through TMDLs and discharge permits.

2.3.3 Recommended Water Quality Approach

To be proactive, the City should begin to address the quality of urban stormwater because of the future Rogue River TMDL, the state anti-degradation policy, and because in the foreseeable future the City is likely to be considered a Phase II community when the population growth reaches 50,000 persons within the specified density.

The following is a recommended approach for improving the City’s urban stormwater quality by potential pollutant.

Temperature

Stormwater runoff alone does not typically result in high thermal loads to water bodies. However, direct routing of runoff to surface waters does decrease groundwater recharge and base flows, which may result in higher summer temperatures. The City should consider the use of infiltration or retention ponds as a primary option for stormwater management. There are retention ponds that would not qualify as UICs. Managing surface flows by matching existing hydraulic conditions will help maintain receiving water body characteristics and may aid in limiting future 303(d) listings (i.e., habitat modification).

Extended wet ponds for water quality treatment and in-line ponds for stock watering or flood control can create high temperatures through long residence times. The SWFMP process will recommend that the City not consider these options for surface water management without assessment of the thermal impact.

TMDLs that have been issued to date require non-point dischargers to reach the shading potential, which in effect, is to plant riparian vegetation along creeks and rivers. The City should identify locations to plant vegetation and consideration should also be given to the protection of existing stream buffers.

Bacteria

The City should implement a program to identify cross connections, sanitary line leaking (near water bodies), and failing septic systems. Animal and pet wastes could be addressed through non-structural best management practices such as public education.

The SWFMP will not use bacteria as a target pollutant when determining effective water quality treatment methods. As noted above, consideration should be given to any facility that may attract wildlife, especially if the facility is directly discharging into waters. If a water quality facility is identified to address other pollutants, retention facilities would also keep bacteria in stormwater from directly discharging into surface waters.

pH

As with bacteria, the SWFMP will not consider this a target pollutant when identifying water quality treatment methods. It is recommended the City wait until the TMDL is developed and identifies the cause of the pH violations.

Total Suspended Solids and Associated Pollutants

The removal of total suspended solids (TSS) is one of the most documented and tracked pollutants in stormwater treatment and many water quality facilities have completed studies to address the removal efficiency of TSS. The efficiency of TSS removal can vary significantly both seasonally and by individual facility. Removal of TSS will often result in the removal of other particulate pollutants which include a percentage of metals and phosphorus. TSS removal will not address dissolved pollutants which includes soluble phosphorus, nitrates, and metals in the dissolved state.

Regardless of the limitations, TSS is still the best parameter to compare and assess various water quality facilities. TSS should be a target pollutant for consideration in a water quality management approach. This includes water quality treatment stormwater flows as well as erosion control. For the SWFMP, the land use based, build-up/wash-off model should be used to identify locations where pollution reduction facilities would best address TSS and the associated particulate pollutants.

Nutrients

Nutrients including phosphorus and nitrogen are found in urban stormwater runoff. These nutrients are found in common fertilizers and phosphorus is often used as a cleaning agent. Typically these dissolved constituents are removed through biological uptake and filtration. The recommended approach is to use vegetated facilities where possible to provide the biological uptake. In addition, providing public information on fertilizer use, native plant selection, etc., will aid in reducing nutrient loads in stormwater.

Toxics and Turbidity

Toxics including pesticides and herbicides are found in urban stormwater runoff. These chemicals are often released as a result of agricultural practices and conversion of agricultural lands to urban development. Developing a blanket policy for treating toxics (in stormwater runoff) is challenging because the decay and treatment process varies by chemical.

The turbidity standard will likely only be addressed in regards to construction practices for sites greater than 1 acres through he states 1200C permit program. Addressing erosion control and promoting vegetation protection especially around water courses is the recommended approach for both of these parameters.

2.3.4 Conclusions

As part of the stormwater facility master planning effort, stormwater quality facilities were identified and included in the improvement recommendations. Water quality treatment methods include vegetated treatment facilities, underground proprietary facilities, and outfall retrofitting as appropriate. These facilities will focus on the removal of TSS, phosphorus, and particulate metals. Facility types were selected based on: treatment area, pollutant load estimates, maintenance, land availability, and overall ability to meet the regulatory programs. Facility locations were identified through the system modeling and improvement recommendation process.

The City should consider implementation of non-structural practices and policies. It is likely that the City will eventually be included as a NPDES Phase II community and the Rogue TMDL should be developed in the next few years (2006-07). Recommended policies include those similar to current Phase II and TMDL actions and include:

- Revisions to the development code to manage post construction water quality;
- Local erosion control permitting and enforcement;
- Buffer ordinances and programs to encourage tree programs;
- Programs to identify illegal dumping (in the storm system) and illicit connections; and
- Programs to identify failing septic systems or failing sanitary lines.

SECTION 3

Planning and Analysis Criteria

A master planning analysis was performed for the City of Grants Pass watersheds to identify potential stormwater improvements. The evaluation was guided by a set of system analysis criteria used to identify conveyance and water quality problem areas and to evaluate potential improvements. These criteria include quantitative assessments of storm drain surcharging, culvert overtopping, channel flooding, outfall erosion and pollutant loading as well as qualitative assessments of channel morphology and natural resource indicators.

This chapter presents the various system analysis criteria used to identify conveyance and water quality problem areas and to evaluate potential improvements.

3.1 Stormwater Modeling

Stormwater master planning was accomplished using a number of criteria that aid in developing analysis tools and identifying problem locations and improvements. The following information summarizes the planning and design criteria, including design storms, boundary conditions, land use, and imperviousness and other design criteria that were used for the SWFMP.

3.1.1 Design Storms

Foremost of the system analysis criteria is the design storm recurrence interval, which directly influences pipe capacity requirements, detention volumes and water quality treatment flows. Table 3.1-1 describes the two design storms used in the Grants Pass Stormwater Facilities Master Plan.

TABLE 3.1-1
Event-based Design Storms
Grants Pass: SWFMP

Recurrence Interval (yrs)	Depth (in)	Distribution	Comments
Water Quality Storm (1/3 of the 2-yr)	0.93	SCS Type 1A (24 hour)	For water quality analysis including regional water quality pond volume requirements and BMP sizing.
Water Quantity Storm (25-yr)	5.0	SCS Type 1A (24 hour)	For analysis and design of public conveyance systems and to determine the maximum volume of regional detention facilities.

3.1.2 Low Impact Development Practices

Low impact development practices are an on-site (i.e. parcel by parcel) stormwater management approach that manages runoff at the source using small-scale stormwater facilities and best management practices (BMPs). The goal of low impact development practices is to mimic a site's predevelopment hydrology by using techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Consequently, as the level of low impact development practices increase within the basin, the need and size of large regional stormwater management systems or improvements decreases. To address the affect low impact development practices will have on stormwater runoff, it was assumed that the new impervious area for all new and redeveloping parcels would be managed with flow control and water quality measures. A more detailed description of the low impact development assumptions is provided in Section 5.2.3.4.

3.1.3 Analysis Scenarios

Land use affects both the quantity (volume and peak) and quality of water being routed though the city's stormwater system. The effect land use has on water quantity is generally linked to the amount of impervious area for a particular land use category. The more impervious the area, the faster the water will be routed to the storm water collection system, due to the lower surface roughness of the ground. It will also increase in volume since infiltration can not occur through impervious surfaces. Consequently, an area with a higher percentage of impervious surfaces will produce higher peak flows over a shorter period of time than will a similar area with a lower percentage of impervious surfaces. In order to identify the current stormwater system deficiencies as well as the likely impacts of future development, three representative scenarios were developed.

3.1.3.1 Existing Conditions

The existing conditions scenario represents 2005 land use within the Grants Pass UGB and reflects the present-day problems within the system.

3.1.3.2 Future Conditions

The future conditions scenario represents a fully developed urban area according to the city's comprehensive plan. This scenario represents the worst case from a stormwater perspective because it encompasses the highest level of imperviousness.

3.1.3.3 Future Conditions with Low Impact Development Practices

The future condition with low impact development scenario represents a fully developed urban area according to the city's comprehensive plan, but it assumes that on-site stormwater management techniques will be used to reduce the new impervious area by 30%.

3.2 System Analysis Criteria

This section covers the proposed criteria used to identify conveyance problems within the six basins. In general, pipe diameters less than 18-inches were not modeled unless these smaller pipe runs connected isolated subbasins to the creek or main storm drain system.

3.2.1 Stormwater Conveyance Elements

Surcharge conditions for the piped system are acceptable only for demonstrating the adequacy of the conveyance system to convey the peak run-off for the design storms, provided that the hydraulic grade line (HGL) is 2-feet lower than the manhole rim elevation. If the HGL is over, or within 2-feet of the manhole rim elevation, that particular section of pipe will be identified as undersized. Based on the previous current stormwater master plan (HGE, 1992) the design storm for evaluating conveyance deficiencies is the 25-yr storm.

3.2.2 Open Channel System

Natural channel reaches will be added to the problem identification list if the design storm causes the channel to overtop its bank based on the 25-year storm event.

3.2.3 Culvert Crossings

There are a number of locations within the city where open channel flow is conveyed through a culvert under a public roadway. Culverts at locations where the model predicts that the HGL will inundate the road sub-grade will be classified as undersized. The roadway sub-grade elevation will be determined by subtracting 1-foot from the roadway crown elevation as determined from the LiDAR contour coverage supplied by the City. Culverts will be evaluated to the 25-yr storm event.

3.2.4 Water Quality Criteria

A water quality analysis was conducted using the XP-SWMM model (discussed in section 6) to identify potential pollutant “hot spots” within the Grants Pass watersheds. The modeled constituents included Total Suspended Solids (TSS), Phosphorus (P), Lead (Pb), Copper (Cu) and Zinc (Zn). Parameters including temperature, pH and bacteria were not be modeled because these cannot be readily analyzed using land use-based methods.

The presence of “hot spots” were identified as areas that exceed appropriate local regulatory limits as presented in Section 6. If no regulatory standard existed, other resources such as Environmental Protection Agency (EPA) toxics guidelines were used to identify concentration limits.

SECTION 4

Study Area Characterization

This chapter presents the study area and basin boundaries, the general topography, the local climatic conditions, the soils and the primary drainage features.

4.1 Study Area

Grants Pass is located along the middle reaches of the Rogue River in southern Oregon. The city's population as of the 2003 census is approximately 24,500 people, making it the second largest city in southern Oregon. The total land area within the city limits (2004) is approximately 9.5 square miles (6,102 acres) and the surrounding urban growth boundary (UGB) encompasses nearly 13.4 square miles (8,550 acres). The city is generally bisected from east to west by the Rogue River, with three primary drainage basins on either side of the river (Figure 1.1-1). To the north (from west to east) are the Gilbert, Skunk and Jones Creek basins and to the south (from west to east) are the Sand, Allen and Fruitdale Creek Basins. Additionally, the city is generally bounded by Interstate-5 on the north, and Highways 99 and 199 to the south.

In terms of land use, a majority of the area within the city limits is fully, or nearly fully developed. The primary areas remaining to be developed (within the UGB but outside of the city limits) are the northwestern portion of the Gilbert Creek basin, known as the Blue Gulch Areas and the southern portions of the Allen and Fruitdale Creek basins. Collectively, the current impervious percentage within the UGB, assuming 2005 land use conditions, is 52%. Under the full buildout scenarios, the future impervious percentage is projected to be 67%. If low impact development practices are used to manage a portion of the runoff from new development, the future imperviousness is projected to be 59%.

4.2 Climate

The regional climate in Grants Pass is affected by the Coast Range and the relative proximity to the Pacific Ocean, bringing warm, dry summers and cool, wet winters. The average annual precipitation is approximately 31 inches (Oregon Climate Service, OCS). Most precipitation (approximately 75%) occurs in the winter months as rain. Average daily high and low temperatures in the summer range from 88 to 52 degree F and in the winter from 50 to 34 degrees F (OCS). Freezing temperatures are not uncommon, but significant snow accumulations are infrequent within the city. The controlling climate conditions, which produce the large high intensity storms, generally occur during the winter months.

4.3 Topography

Topographically, Grants Pass is located in the Coastal Range at an elevation of approximately 1,000 feet mean sea level (msl). Elevations in the mountains surrounding the city range from 1550 feet (msl) in the Cathedral Hills which separate Allen Creek and Fruitdale Creek to nearly 2800 feet (msl) at Baldy Mountain to the immediate southeast of the city. Further away from the city but still within the Rogue River basin, elevations are in excess of 4000 feet (msl). Surface slopes within the UGB vary significantly. In the Sand Creek basin, average surface slopes are less than 1%, while in the Blue Gulch area, slopes in excess of 80% are not uncommon (Figure 4.3-1).

4.4 Soils

According to the Unified Classification system from the Soil Survey Geographic (SSURGO) for Josephine County, Oregon (NRCS, 2005), nearly 70% of the soils within the Grants Pass UGB are of a sandy loam variety (Figure 4.4-1). This type of soil has a relatively low infiltration capacity (high runoff potential) and dominates the Allen, Sand and Gilbert Creek Basins. Further to the east, the Skunk, Jones and Fruitdale Creek basins are comprised of a mix of soil types, in addition to sandy loam, including clayey, silty, gravelly and cobbly loams. Hydrologically speaking, these soil varieties are largely classified as type B and C according to the Natural Resources Conservation System (NRSC, formerly the Soil Conservation Service), which indicates moderate to low infiltration rates (relatively high runoff potential).

4.5 Watersheds

The major drainage basins within the Grants Pass UGB (Figure 1.1-1) were grouped into four analysis basins for the purposes of this SWFMP. They are briefly described below in the sequence in which they were analyzed.

4.5.1 Sand Creek Basin

The Sand Creek basin, which is South of the Rogue River, is the westernmost watershed within the UGB. The basin encompasses approximately 4,510 acres, 1,060 of which are within the UGB. Sand Creek itself is approximately 4.2 miles long and flows in a northerly direction to its confluence with the Rogue River near Leonard Road and Boundary Road. Sand Creek has one major unnamed tributary that enters the creek approximately 2,500 feet upstream of the UGB. In addition to Sand Creek, two irrigation canals bisect the basin from east to west. At various locations tributary to these canals, runoff is intercepted by the South Main Canal or the South Highline Canal and conveyed either directly to Sand Creek in the winter, or further west for irrigation purposes in the summer.

The existing storm drain system within the UGB is comprised of several large pipe systems that flow north along Darneille Lane, Kokanee Lane, Willow Lane and Kellenbeck Road. Each of these storm drains ultimately discharge to large open channels north of the UGB before discharging to the Rogue River. On the east side of the Sand Creek basin, three other storm drain systems collect runoff along Redwood Avenue, and flow north down Dowell Road, Wineteer Lane and Redwood Circle and discharge directly to the Rogue River.

The existing impervious percentage within the UGB is approximately 50% and is primarily made up of the single family residential land use. Some commercial and industrial areas are also present on the eastern side of the basin along Redwood Avenue and Redwood Highway (Hwy 199). Outside of the UGB, the land use is primarily rural residential, agricultural and forest and consequently has a low impervious percentage.

4.5.2 Gilbert Creek Basin

The Gilbert Creek basin is the westernmost basin north of the Rogue River and encompasses approximately 4,850 acres, about half of which are located within the Grants Pass UGB. The headwaters of the basin originate in the foothills immediately north and northwest of Grants Pass. Gilbert Creek itself originates several thousand feet upstream of Interstate-5 and flows approximately 3.2 miles south to is confluence with the Rogue River west of 5th Street. The upper reaches of the creek (north of I-5) are steeply sloped and less developed than the lower, urbanized reaches, which flows through the established downtown area of Grants Pass. Two primary irrigation canals, the Tokay Canal and the Demarey Canal, bisect the basin from east to west. At various locations tributary to these canals, runoff is intercepted and conveyed either directly to Gilbert Creek via diversion structures and the existing storm drain system, or further west for irrigation purposes depending on the season.

North of the downtown area, the existing storm drain system includes several large pipes that convey flows east or west along Morgan Lane, Hillcrest Drive, ‘B’ Street and Highland Avenue (north of Parker Drive) into Gilbert Creek. Within the downtown area, runoff is conveyed along 5th, 6th, 7th and 9th Street directly to the Rogue River. Runoff generated in the residential areas east of downtown is also conveyed directly to the Rogue River via pipe systems along Lincoln Road, Spruce Street and Greenwood Avenue.

The Gilbert Creek basin is heavily developed within the UGB with an existing imperviousness of approximately 51%. Runoff collected in the ‘B’ Street storm drain system originates in the Blue Gulch area. This area represents a significant portion of the UGB that has yet to be developed, but will be in the near future. Outside of the UGB, development levels are relatively low, with the predominant land use being rural residential, and forest.

4.5.3 Allen Creek and Fruitdale Creek Basins

The Allen Creek basin is located immediately east of the Sand Creek basin on the south side of the Rogue River. The basin has a total area of approximately 4,620 acres with roughly 2,070 acres inside the UGB. Allen Creek itself is approximately 2.8 miles long and flows directly north to its confluence with the Rogue River adjacent to the Josephine County Fairgrounds. Two primary irrigation canals, the South Main Canal and the South Highline Canal, bisect the basin from east to west and either direct runoff to Allen Creek or capture runoff and convey it west for irrigation purposes outside the UGB.

The existing storm drain system in the Allen Creek basin includes three distinct elements; 1) storm drains that discharge directly to the Rogue River; 2) storm drains that discharge directly to Allen Creek; and 3) storm drains that discharge to the two primary irrigation canals. The areas that directly discharge to the Rogue River are located generally to the north of Redwood Highway (Highway 199) and the Rogue River Highway (Highway 99). Several large pipe systems (> 24" diameter) along West Park Street, Highway 99 and Highway 199, Sunset Way, Park Drive and Fruitdale Drive (via Parkdale Drive) provide the primary conveyance in this area and discharge at a series of outfalls along the river. The storm drains that discharge directly to Allen Creek include a number of relatively small pipe systems (24" and less) that collect localized runoff and direct it laterally into Allen Creek. The areas that discharge to the South Main Canals are generally located between the South Highline Canal and the South Main Canal and are heavily urbanized. The urban areas that discharge to the South Highline Canal include several small subdivisions located east of Highway 238. Additionally, much of the runoff from the area upland (south of the South Highline Canal in the Cathedral Hills) is also intercepted by the South Highline Canals and conveyed to Allen Creek.

The Fruitdale Creek basin is located to the east of the Allen Creek basin and encompasses a total area of roughly 4,400 acres, 408 of which are located within the UGB. The creek itself is approximately 2 miles long and flows north to its confluence with the Rogue River between East Park Street and Riverside Drive. Two primary irrigation canals, the Tokay Canal and the Demarey Canal, bisect the northern portion of the basin from east to west. At various locations tributary to these canals, runoff is intercepted and conveyed either indirectly to Skunk Creek via diversion structures and the existing storm drain system, or further west to Gilbert Creek for irrigation purposes depending on the season.

The existing storm drain system within the Fruitdale Creek basin is comprised of a number of pipe systems that collect localized runoff and direct it laterally along Panoramic Loop, Fruitdale Drive and Highway 99 into Fruitdale Creek. Both the South Main Canal and the South Highline Canal also intercept runoff to the east of the city and discharge it to Fruitdale Creek at several spillpoints.

In terms of overall land use within the two basins, the lower portions along the Rogue River Highway (Hwy 99) and Redwood Highway (Hwy 199) are heavily developed with the primary land uses being medium density residential and commercial. Further south, but still within the UGB, the development becomes less dense, with the dominant land use categories being medium density residential and open space. Collectively, the existing imperviousness of the two basins within the UGB is 44%. Outside of the UGB, development levels are relatively low, with the predominant land use being rural residential and forest.

4.5.4 Skunk Creek and Jones Creek Basins

The Skunk Creek and Jones Creek basins are located to the north of the Rogue River and on the eastern side of the UGB. The Skunk Creek basin, which is the smallest of the basins within the study area and almost entirely within the UGB, is located east of the Gilbert Creek basin. The basin has a total area of approximately 2,360 acres with roughly 1,933 acres (82%) inside the UGB. Skunk Creek itself is approximately 1.3 miles long and flows directly south, crossing beneath a number of roads, to its confluence with the Rogue River west of the Highway 199 bridge crossing. Two primary irrigation canals, the South Main Canal and the South Highline Canal, bisect the basin from east to west and either direct runoff to Skunk Creek or capture runoff and convey it to Gilbert Creek or west for irrigation purposes outside the UGB.

The existing storm drain system within the Skunk Creek basin is comprised of three distinct elements; 1) areas that drain directly to the Rogue River, 2) areas that drain directly to Skunk Creek and 3) areas that drain to the Mill Street drainageway. The areas that discharge to the Rogue River are located generally to the south of the Central Oregon & Pacific Railroad and to the east of Highway 199. Three primary pipe systems along SE Rogue Drive, SE Herrick Lane and SE Rose Lane collect and convey runoff from this area to a series of outfalls along the Rogue River. The storm drains that discharge directly to Skunk Creek include several relatively small pipe systems (24” and less) along 6th and 7th Streets in the northeastern portion of the basin as well as localized surface runoff from the immediate vicinity of the creek. The remaining portion of the basin (north of the Central Oregon & Pacific Railroad and east of Skunk Creek) area collect and convey runoff to the Mill Street drainageway via storm drains along NE Spaulding Avenue, Highway 199, NE ‘D’ Street and the two irrigation canals.

The Jones Creek basin is the largest of the watersheds being analyzed at 5,020 total acres but represents the smallest area within the UGB at 296 acres. The creek itself is approximately 3.6 miles long and flows south via two tributaries into the Rogue River at the eastern edge of the UGB. No significant storm drain system currently exists within the basin.

In terms of overall land use within the two basins, the portions within the UGB encompass roughly 2,230 acres and have a net imperviousness of 59%. Outside of the UGB, development levels are relatively low, with the predominant land use being rural residential and forest.

4.6 Grants Pass Irrigation District

The Grants Pass Irrigation District (GPID) owns and operates a number of irrigation canals and laterals that convey irrigation water through the city in a general east to west direction (Figure 4.6-1). Although these facilities are irrigation canals, they also intercept and convey stormwater runoff. To the south of the Rogue River, the primary GPID canals are the Gravity Canal, the South Main Canal and the South Highline Canal. The Tokay Canal and the Demaray Canal provide the primary irrigation services on the north side of the Rogue River. During the summer months (May to September), these canals are fed by flows diverted from the Rogue River at Savage Rapids Dam. During the winter months (October to April), runoff from upland areas are collected in the canals and diverted into the nearby creeks system. Additionally, it is not uncommon during the winter for areas tributary to the canals to generate flows that are in excess of the canal capacity causing widespread flooding.

As the storm drain system currently exists (2006), the canals play an integral role in the collection, conveyance and discharge of urban runoff within the UGB. It is not uncommon to have the canals serve as points of discharge (i.e. piped outfalls are directly connected to the canals) for small to medium size developments throughout the city. This issue is compounded by the fact that the City and GPID do not have a formal agreement in place outlining how stormwater runoff and irrigation transmissions are to be co-managed.

SECTION 5

Hydrologic and Hydraulic Model Development

A key element in the master planning process is the development of a hydrologic and hydraulic model of the watershed and its natural and man-made stormwater system. The model should be capable of analyzing control strategies for basin master planning; predicting flooding risk; evaluating existing facilities and infrastructure; supporting geomorphic and natural resource evaluations and designing proposed facilities.

This chapter presents the development and calibration of the XP-SWMM model used in the Grants Pass SWFMP. Included are a description of the XP-SWMM model, the data requirements, the data sources, the model setup and the model calibration. The development of the water quality model is also discussed in this section.

5.1 Model Description

A critical piece of the stormwater system analysis is the selection of an appropriate set of predictive hydrologic and hydraulic models. The chosen modeling tool, XP-SWMM, which is a commercially enhanced version of the U.S. EPA SWMM model, was selected because it is capable of predicting the quantity and quality of runoff and evaluating the hydraulic performance of existing facilities (channel, pipes, culverts, etc.) designing proposed facilities.

5.1.1 Data Sources

The primary sources of data used in this master plan originated from 1) the City's GIS database, 2) direct discussion with City staff, 3) field reconnaissance/data collection, and 4) as-built drawings and survey records. Other sources of data were the 1982 Master Storm Drainage Facilities and Management Plan for the Grants Pass Urban Growth Boundary Area (HGE, Inc.), the Draft Allen Creek Drainage Master Plan (RVCOG, 2003), the City of Grants Pass Stormwater and Open Space Program Development Plan (RVCOG, 2003), the Grants Pass Water Quality Monitoring Plan (RVCOG, 2005), the Newton Report (Grants Pass Irrigation District, Water Management Study, 1994) and the Galli Report (Surface Water Management Study, GPID Irrigation Canals, Northeast Grants Pass, Oregon, 1995).

5.1.2 Basin Sequencing

Basin models were developed individually to facilitate the system analysis process. Basin modeling and analysis were sequenced in the following order: 1) Sand Creek Basin, 2) Gilbert Creek Basin, 3) Allen and Fruitdale Creek Basins, and 4) Skunk and Jones Creek Basins.

5.2 Model Construction

This section presents the hydrologic and hydrologic model inputs and the calibration/sensitivity analysis results. Because of the nature and capabilities of XP-SWMM, data requirements are extensive. Numerous inputs are required for both the hydrologic (rainfall-runoff) and hydraulic (routing) portions of the analysis and are individually summarized in the following sections. The model network was mapped with the node and link elements labeled for each subbasin and are included in Appendix A.

5.2.1 Subbasin Boundaries

One of the key tasks in building a hydrologic model is to allocate flows from individual subbasins to their respective conveyance element. In addition, the spatial arrangement between these subbasins in the model must represent actual ground conditions. Gridded LiDAR data, provided by the City, were processed using GIS software to examine the topography of each basin. Subbasin delineation throughout the city was based on topography, the existing storm drain system, GPID canal system and the existing roadway network. Ultimately, 604 subbasins were used to delineate the City's storm drain system. Aerial photographs and site reconnaissance at selected locations were also used as a means to verify the subbasin boundaries.

5.2.2 Basin Width and Slope

Basin width represents the physical width of overland flow and essentially determines the time lag between peak precipitation and peak runoff. Basin width values were determined by dividing the length of the longest flow path by the subbasin size. This length was determined by measuring the distance from the upper-most point in the subbasin, through the overland and stormwater conveyance path, to the most downstream point in the subbasin.

Subbasin slope also influences the runoff travel time and resulting hydrograph shape. Subbasin slopes were determined by intersecting the longest flow path noted above with the gridded LiDAR data at the end points and dividing the total elevation difference by the flow length.

5.2.3 Infiltration and Surface Parameters

Infiltration is the process by which surface water percolates into the subsurface soil and groundwater column. Infiltration is an important hydrologic process because it governs groundwater recharge, soil moisture storage, and surface water runoff. As modeled in the XP-SWMM runoff block, infiltration is one of several processes that represent a withdrawal of a portion of total storm precipitation that could otherwise generate surface runoff. The method for computing infiltration incorporates soils, land use conditions and impervious cover to estimate loss rates. Each of these parameters is described below.

5.2.3.1 Soil Infiltration Data

Information on soil types and characteristics for each watershed were compiled from the NRCS SSURGO dataset for Josephine County. Each basin consists of many soil varieties and for modeling purposes, the different soil varieties were grouped into 7 basic soil groups. These groups are Sandy Loam (SL), Gravelly Sandy Loam (GSL), Coarse Sandy Loam (CSL), Gravelly Loam (GL), Fine Sandy Loam (FSL), Loam (L) and Silty Clay Loam (SCL). For each soil group, a set of Green-Ampt infiltration parameters including Average Capillary Suction, Initial Moisture Deficit and Saturated Hydraulic Conductivity were compiled (Table 5.2-1). Using GIS, the predominate soil type in each subbasin was identified and input into the XP-SWMM model database.

TABLE 5.2-1
Soil Infiltration Parameters
Grants Pass: SWFMP

Green-Ampt Parameters[1]	SL	GSL	CSL	GL	FSL	L	SCL
Average Capillary Suction (in)	4.33	4.33	4.33	4.33	4.33	3.50	10.75
Initial Moisture Deficit	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Saturated Hydraulic Conductivity (in/hr)	0.3	0.4	0.4	0.4	0.2	0.3	0.08

1. Maidment (1993), adjusted during calibration

5.2.3.2 Subbasin Runoff Parameters

In addition to the soil infiltration rates, XP-SWMM also requires surface parameters that control the amount of immediate runoff and the rate of runoff from overland areas. There are three parameters required: depression storage, zero detention and Manning's "n" (see Table 5.2-2). Depression storage defines the amount of rain that must fall before runoff can occur in a subbasin, while the zero detention parameter controls the amount (area) of a subbasin that has immediate runoff, or the area that has no depression storage. Manning's "n" is used to calculate the time it takes for precipitation to be transformed to runoff. Higher values of Manning's "n" represent rougher surfaces like grass where runoff times will be delayed. Low values represent impervious areas such as roads or parking lots and produce higher peak flows with little or no runoff delay.

TABLE 5.2-2
Subbasin Runoff Parameters
Grants Pass: SWFMP

General Runoff Parameters[1]	Impervious Area	Pervious Area
Depression Storage (in)	0.013	0.1
Manning's "n"	0.02	0.1 - 0.25
Zero Detention (%)	10%	n/a

1. XP-SWMM documentation, adjusted during calibration

5.2.3.3 Existing Land Use and Imperviousness

Land use affects both the quantity (volume and peak) and quality of water being routed though the stormwater system and natural channels. The effect land use has on water quantity is generally linked to the amount of impervious area for a particular land use category. The more impervious the area, the faster the water will be routed to the storm water collection system, due to the lower surface roughness of the ground. It will also increase in volume since infiltration can not occur through impervious surfaces. Consequently, an area with a higher percentage of impervious surfaces will produce higher peak flows over a shorter period of time than will a similar area with a lower percentage of impervious surfaces. Figures 5.2-1 and 5.2-2 illustrated the existing land use and the existing impervious percentage within the UGB respectively.

Existing impervious percentages for each subbasin within in the XP-SWMM model were established using a GIS analysis that combined county parcel maps, the County Assessors' property classification database and the impervious percentages listed in the Allen Creek Drainage Master Plan (Table 4.2.3-3). This process is outlined as follows:

- The county parcel maps were joined with the Assessors' property classification database to spatially describe the existing land use within the watershed.
- The 90 property classification categories in the Assessor's database were refined down to seven general land use categories for stormwater modeling; Open/Agricultural (OPEN), Low Density Residential (LDR), Medium Density Residential (MDR), High Density Residential (HDR), Commercial (COM), Industrial (IND) and Transportation (TRANS).
- The impervious percentages for each land use category were based on the Allen Creek Drainage Master Plan. The impervious percentages were joined to the parcel dataset and intersected with the subbasin coverage to establish net impervious percentages for each subbasin.

TABLE 5.2-3
Existing Condition Land Use Categories and Impervious Percentages
Grants Pass: SWFMP

Land Use Category	Assessor's Property Classification Description	Impervious Percentage (%)
OPEN	Open Space, Vacant Land, Forest	5
LDR	Rural Residential, Low Density Residential	28
MDR	Medium Density Residential	45
HDR	High Density Residential, High Rise, Mobile Home	75
COM	All Commercial	80
IND	All Industrial	85
TRANS	Transportation System and Right-of-Way	90

5.2.3.4 Future Land Use and Imperviousness

The future land use scenario is characterized in Table 5.2-4 on an individual land use basis and graphically by the Grants Pass Comprehensive Plan (Figure 5.2-3). This scenario results in the highest level of imperviousness using typical development practices (Figure 5.2-4).

TABLE 5.2-4
Future Condition Zoning Land Use Categories and Impervious Percentages
Grants Pass: SWFMP

Land Use Category	Zoning Code	Impervious Percentage (%)
OPEN	WR	5
LDR	RR-1, RR-5	28
MDR	R-1-12, R-1-10, R-1-8	45
HDR	R-1-6, R-2, R-3, R-4	75
COM	NC, C2, RTC-1, -2, -3, GC, C3, -4, -5, -6, CBD	80
IND	IP, MP, BP, M-1	85
TRANS	All public right-of-way	90

Measure 37

The Measure 37 land use regulation in Oregon creates the possibility of land use densification above and beyond the current zoning levels outside of the UGB. Stormwater runoff from the upper basin and outside the UGB has an impact on the capacity of the City's storm drain system. Densification and the resulting increase in imperviousness places an increased demand on the City's storm drainage system. As a means to approximate the impact of this administrative rule, the following procedure was used to account for the likeliest densification outside of the UGB:

- Within a 100' buffer outside of the UGB, all parcels with the rural or low density residential zoning classification were assigned the medium density residential classification to account for Measure 37 densification.
- Parcel zoned as wood lots (existing forested areas that have the OPEN land use category) were assigned the rural residential (LDR) category to account for other likely Measure 37 densification.
- All other parcels outside of the UGB were assigned their corresponding zoning category as listed in Table 5.2-4.

Although this process provides an approach to incorporate the possible impacts of Measure 37, it is recognized that the actual impacts of this land use law may differ from the present analysis. Nonetheless, the buffering approach offers a conservative method whereby the land use densification is assumed to occur immediately adjacent to the UGB as shown on Figure 5.2-4. Consequently, this will results in an increase in runoff and conveyance requirements for the existing and proposed drainage network within the City's UGB.

Low Impact Development Practices

Low impact development practices are an on-site (i.e. parcel by parcel) stormwater management approach that manages rainfall at the source using small-scale stormwater facilities and best management practices (BMPs). The goal of the low impact development practices is to mimic a site's predevelopment hydrology by using techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Consequently, as the level of low impact development practices increase within the basin, the need and size of large regional stormwater management systems or improvements decreases. The effectiveness of low impact development practices to manage stormwater, however, can be diminished in steeper areas. Figure 5.2-5 illustrates the portions of the city where excessive slope (>10%) exist and the application of appropriate low impact development tools needs additional review. For these areas, engineers should consult with city staff prior to planning and designing stormwater facilities and low impact development infrastructure.

To address the affect of low impact development for the future condition (full buildout) scenario, a second future condition land use scenario was established. At a city-wide scale, low impact development practices were assumed to reduce the future impervious percentage by 30% for undeveloped and redeveloping parcels. The 30% impervious area reduction was determined by evaluating typical development footprints associated with single family residential parcel, small-scale commercial parcel and a large campus commercial facility development while making appropriate and conservative assumptions for long term maintenance and performance. For an example of how the impervious area reduction was applied, consider that a newly constructed commercial parcel without low impact development practices would have an imperviousness of 80%. However, if low impact development techniques are used, the imperviousness would be reduced to 56%. Figure 5.2-6 illustrates and table 5.2-5 summarizes the impervious percentage for each land use category using low impact development practices.

TABLE 5.2-5
LID Impervious Percent Reduction Factors
Grants Pass: SWFMP

Land Use Category	Impervious Percentage	Effective Mitigation through Low Impact Development (%)	LID Impervious Percentage
OPEN	5	0	5
LDR	28	30	20
MDR	45	30	32
HDR	75	30	53
COM	80	30	56
IND	85	30	60
TRANS	90	30	63

Although low impact development practices can easily be applied to new construction, redevelopment of some parcels may not involve significant new construction; rather minor modifications to the existing site would be more common. Opportunities for low impact development practices on these parcels would be significantly lower. To address this, the level of low impact development assigned to each parcel was related to the change in land use as follows:

- If the impervious percentage of a parcel changes by more than 15%, then it was assumed that the existing site would be fully demolished prior to redevelopment and low impact development techniques would by fully applied to the parcel.

- If the impervious percentage of a site changes by less than 15%, then low impact development techniques were assumed to occur for only the new imperviousness between area (i.e., the change between the existing and future land use categories).

For example, if a low density residential parcel (28% impervious) is zoned as industrial (85%), it was assumed the existing site would be fully demolished and low impact develop could be applied to the entire parcel, resulting in a net imperviousness for the parcel of 60% (Table 5.2-5). Alternatively, if an existing parcel is high density residential (75% impervious) and it is zoned as commercial (80% impervious), then only 5% (80% - 75%) of the parcel was assumed to use low impact development techniques and the resulting net impervious percentage for the parcel would be 78% (80% - (5% x 30%)).

5.2.4 Hydraulic Data

As mentioned previously, each basin includes natural and manmade conveyance elements. XP-SWMM models each of these features together as a complete hydraulic system.

5.2.4.1 Storm Drain and Manhole Data

The storm drain pipe and manhole data used for model construction were developed from two sources. At the planimetric level, the City's GIS storm drain and manhole data layers were used to develop a system schematic map. With this in-hand, field surveys were made at each key manhole within the system to verify the GIS data layer as well as measure manhole and pipe invert depths. Then, using the LiDAR raster dataset as a topographic base, the manhole rim elevations were determined in GIS. Lastly, the manhole sump and pipe invert elevations were determined by subtracting the field-measured depths from the LiDAR derived rim elevations. As previously noted, storm drains greater than 18" in diameters were analyzed in the XP-SWMM model.

As a means to verify the vertical accuracy of this approach, numerous data points were collected at key manholes using survey-grade (>cm accurate) GPS units. These data points were then compared to the LiDAR elevations. Overall, this process indicated that the LiDAR dataset has a likely accuracy of better than 3 inches, which is sufficient for this level of analysis. As improvement projects progress into the design phase, location specific topographic surveys are recommended for the basis of design.

5.2.4.2 Open Channels

Open channel data, including major roadside ditches, streams and irrigation canals were extracted from the LiDAR dataset. The LiDAR data were used to determine channel cross-sections and slopes. Roughness estimates for each open channel element were derived from high resolution aerial photograph and/or field observations.

5.2.5 Boundary Conditions

Boundary conditions for the XP-SWMM model were imposed at the downstream limit of the model on the Rogue River. These boundary conditions were assigned to represent average flow conditions (i.e., no flooding). Although flood flows in the Rogue River would impact the surface runoff and drainage immediately adjacent to the river, elevations within the Urban Growth Boundary are sufficiently above the corresponding water surface in the Rogue River that a free outfall condition is appropriate for modeling the stormwater collection system. For example, the 100-year water surface elevation for the Rogue River at the upstream end of the Sand Creek basin is 895'. Minimum storm drain invert elevations in that same location are approximately 910'. Likewise, Rogue River flood elevations at its confluence with Sand Creek are around 880' and surrounding ground elevations are again more than 10 feet above this stage. Consequently, a free outflow condition was assigned at the downstream end of each drainage course that enters the Rogue River.

Boundary conditions were also applied for the irrigation canals within each of the basin hydraulic models. These conditions establish the discharge within the canals prior to receiving runoff resulting from a major storm event. The upstream end of each irrigation canals was assumed to be flowing at the maximum capacity of a limiting structure (e.g. culvert) prior to receiving runoff. The applied condition also assumed that all canal flows would spill at the creek crossings. Between the creek crossings, the canals would intercept and convey the entire contributing runoff to the subsequent creek crossing.

5.3 Basin Model Summary

This section provides a brief description of the model development for each basin. The hydraulic (conveyance) models for the each of the four basins were constructed based on the primary drainage system and include storm drain pipe diameters greater than 18 inches, culverts, and open channels.

5.3.1 Sand Creek Basin

Hydrologically, 99 subbasins were delineated to direct runoff to the appropriate stormwater conveyance element. Open channels included Skunk Creek, Jones Creek, the Mill Street Channel, the Tokay Canal, the Demaray and Leigh Laterals, and roadside ditches necessary to provide connectivity of the conveyance system. Land use and associated levels of imperviousness for each analysis scenario are summarized in Table 5.3-1.

TABLE 5.3-1
Land Use Summary
Grants Pass: Sand Creek Basin

Location	Total Area (acres)	Imp. Area (acres)	Impervious (%)
Existing Condition within the UGB	1,060	531	50%
Future Condition within the UGB		750	71%
Future Condition with Low Impact Development within the UGB		642	61%
Existing Conditions outside of the UGB	3,452	776	22%
Future Condition outside of the UGB		916	27%
Future Condition with Low Impact Development outside of the UGB		850	25%

5.3.2 Gilbert Creek Basin

Hydrologically, 161 subbasins were delineated to direct runoff to the appropriate stormwater conveyance element. Open channels included Gilbert Creek, the Tokay Canal, the Demaray and roadside ditches necessary to provide connectivity of the conveyance system. Land use and associated levels of imperviousness for each analysis scenario are summarized in Table 5.3-2.

TABLE 5.3-2
Land Use Summary
Grants Pass: Gilbert Creek Basin

Location	Total Area (acres)	Imp. Area (acres)	Impervious (%)
Existing Condition within the UGB	2,518	1,273	51%
Future Condition within the UGB		1,656	66%
Future Condition with Low Impact Development within the UGB		1,444	57%
Existing Conditions outside of the UGB	2,334	311	13%
Future Condition outside of the UGB		509	22%
Future Condition with Low Impact Development outside of the UGB		437	19%

5.3.3 Allen Creek and Fruitdale Creek Basins

Hydrologically, 170 subbasins were delineated to direct runoff to the appropriate stormwater conveyance element. Open channels included Allen Creek, Fruitdale Creek, the South Main and South Highline irrigation canals, and roadside swales necessary to provide connectivity of the conveyance system.

TABLE 5.3-3
Land Use Summary
Grants Pass: Allen Creek and Fruitdale Creek Basins

Location	Total Area (acres)	Imp. Area (acres)	Impervious (%)
Existing Condition within the UGB	2,478	1,092	44%
Future Condition within the UGB		1,447	58%
Future Condition with Low Impact Development within the UGB		1,276	51%
Existing Conditions outside of the UGB	6,541	1,160	18%
Future Condition outside of the UGB		1,648	25%
Future Condition with Low Impact Development outside of the UGB		1,457	22%

5.3.4 Skunk Creek and Jones Creek Basins

Hydrologically, 174 subbasins were delineated to direct runoff to the appropriate stormwater conveyance element. Open channels included Skunk Creek, Jones Creek, the Mill Street Channel, the Tokay Canal, the Demaray and Leigh Laterals, and roadside ditches necessary to provide connectivity of the conveyance system. Land use and associated levels of imperviousness for each analysis scenario are summarized in Table 5.3-4.

TABLE 5.3-4
Land Use Summary
Grants Pass: Skunk Creek and Jones Creek Basins

Location	Total Area (acres)	Imp. Area (acres)	Impervious (%)
Existing Condition within the UGB	2,229	1,313	59%
Future Condition within the UGB		1,548	69%
Future Condition with Low Impact Development within the UGB		1,407	63%
Existing Conditions outside of the UGB	5,542	731	13%
Future Condition outside of the UGB		1,068	19%
Future Condition with Low Impact Development outside of the UGB		941	17%

5.4 Model Calibration

The goal of model calibration is to adjust a set of model parameters so that the measured runoff and streamflow for a given storm event match the predicted runoff or streamflow from the corresponding model calculation. Calibration is performed to make the hydrologic or hydraulic processes simulated by the model more representative of the actual conditions in the basin. The following sections describe the calibration process and results for each basin within the city.

5.4.1 Sand Creek Basin

The procedure used for calibrating the Sand Creek watershed runoff model was to iteratively run XP-SWMM and refine the input parameters such as basin roughness and infiltration rates to minimize the difference between the measured and simulated streamflows. Because actual streamflow measurements were not available for Sand Creek and datasets recently collected by the Rogue Valley Council of Governments (RVCOG) in neighboring Allen, Skunk and Gilbert Creeks do not cover a sufficiently long period of record, a basin transfer methodology was used to scale peak flow statistics from a nearby stream (Jones Creek USGS# 14361300, just to the north east of Grants Pass). Due to development within the lower portion of the Sand Creek basin, the most appropriate location to calibrate the Sand Creek model was at Jerome Prairie Road/Demaray Drive, which generally represents the lowest point in the basin without significant urbanization. The location was selected because the flow statistics from the Jones Creek basin also reflect generally unurbanized land use and runoff.

5.4.1.1 Calibration Results

Results from the calibration process, shown in Table 5.4-1 and Figure 5.4-1, indicate that the final inputs to the hydrologic/hydraulic model were able to reproduce the peak runoff response in the watershed.

For returns period between 5- and 100-yr, the difference between the model predictions and the transferred Jones Creek statistics vary by less than 8%. During the smaller 2-yr event, the difference is somewhat greater (33%); however results from the validation process (described below) bound the calibrated model results. Consequently, given the limited data availability, the model results for each of the six return periods listed in Table 5.4-1 seem reasonable.

TABLE 5.4-1
Summary of Calibration Results
Grants Pass: Sand Creek Basin

Location	Return Period (yr)	Jones Creek (transferred to Sand Creek)	Model Results	
		Peak (cfs)	Peak (cfs)	Difference[1] (%)
Sand Creek @ Redwood Highway	2	129	172	33
	5	223	230	3
	10	299	297	1
	25	403	392	3
	50	487	456	6
	100	581	534	8

1. Difference represents model results vs. USGS transfer results; cfs = cubic feet per second
USGS = United States Geological Survey.

As a means to further verify the hydrologic model's capability to predict peak flows, the USGS regional regression equations were applied to the same drainage area above Jerome Prairie Road. Results, shown in Table 5.4-2 and Figure 5.4-1, verify the model parameters used in this analysis.

TABLE 5.4-2
Summary of Verification Results
Grants Pass: Sand Creek Basin

Location	Return Period (yr)	USGS Regional Regression		Model Results	
		Peak (cfs)	Standard Error (%)	Peak (cfs)	Actual Error[1] (%)
Sand Creek @ Redwood Highway	2	191	44	172	11
	5	289	43	230	20
	10	356	44	297	17
	25	448	46	392	13
	50	520	49	456	12
	100	590	51	534	9

1. Actual error represents model results vs. USGS regression results; cfs = cubic feet per second
USGS = United States Geological Survey.

5.4.2 Gilbert Creek Basin

The procedure used for calibrating the Gilbert Creek basin runoff model was similar to the Sand Creek analysis whereby XP-SWMM was iteratively run and input parameters refined to minimize the difference between the measured and simulated streamflows. Again, due to limited data, the Jones Creek basin transfer approach was used as the basis for comparison. It should be noted that these transferred flow statistics are published in the Gilbert Creek Flood Insurance Study (FEMA, 2004). Due to the high level of urbanization in the Gilbert Creek basin and the relatively low level in the Jones Creek basin, a direct comparison of runoff could not be performed. Instead, the impervious percentage of the Gilbert Creek basin was reassigned to represent undeveloped conditions (approximately 15% basin-wide). The XP-SWMM model was then rerun and peak flow statistics at three locations within the basin were directly compared to those from Jones Creek. Following calibration, the impervious percentages were reassigned to their existing conditions values for the subsequent system evaluation.

5.4.2.1 Calibration Results

Results from the calibration process, shown in Table 5.4-3 and Figure 5.4-2, indicate that the final inputs to the hydrologic/hydraulic model are able to accurately reproduce the peak runoff response in the watershed. For returns periods between 10- and 100-yr, the difference between the model predictions and the FIS vary by less than 8%.

TABLE 5.4-3
Summary of Calibration Results
Grants Pass: Gilbert Creek Basin

Location	Return Period (yr)	Gilbert Creek FIS (Transferred Jones Creek Statistics)	Model Results	
		Peak (cfs)	Peak (cfs)	Difference[1] (%)
Gilbert Creek at the Rogue River	10	531	530	0%
	25	705	682	3%
	50	836	791	5%
	100	973	892	8%
Gilbert Creek at "B" Street	10	484	517	-7%
	25	641	664	-4%
	50	760	771	-1%
	100	885	887	0%
Gilbert Creek at Hillcrest Avenue	10	398	414	-4%
	25	527	525	0%
	50	625	603	4%
	100	728	688	5%

1. Difference represents model results vs. FIS results; cfs = cubic feet per second
USGS = United States Geological Survey

5.4.3 Allen Creek and Fruitdale Creek Basins

The procedure used for calibrating the Allen Creek and Fruitdale Creek basins is the same as the procedure used in the calibrating the Sand Creek basin.

5.4.3.1 Calibration Results

Results from the calibration process, shown in Tables 5.4-4 and 5.4-5, indicate that the final inputs to the hydrologic/hydraulic model are able to accurately reproduce the peak runoff response in the watershed. This information is also presented on Figures 5.4-3 and 5.4-4. For return periods between 25- and 100-yr, the difference between the model predictions and both the Jones Creek flow statistics and the regional regression predictions vary by less than 15%. However, during the smaller 2-year event, the difference is greater (40% and 29% for Allen Creek and Fruitdale Creek, respectively). Given the limited data availability and fact that the conveyance system analysis is based on the larger 25-year event, the model results for each of the four return periods listed in Table 5.4-4 are appropriate for this planning level analysis.

TABLE 5.4-4
Summary of Calibration Results (basin transfer method)
Grants Pass: Allen and Fruitdale Creek Basins

Location	Return Period (yr)	Gilbert Creek FIS (Transferred Jones Creek Statistics)	Model Results	
		Peak (cfs)	Peak (cfs)	Difference (%)
Allen Creek at UGB	2	120	198	-40
	10	279	325	-14
	25	376	412	-9
	100	541	561	-4
Fruitdale Creek at UGB	2	163	230	-29
	10	380	386	-2
	25	514	498	3
	100	743	678	10

cfs = cubic feet per second; USGS = United States Geological Survey.

TABLE 5.4-5
Summary of Calibration Results (USGS Regional Regression method)
Grants Pass: Allen and Fruitdale Creek Basins

Location	Return Period (yr)	USGS Regional Regression		Model Results	
		Peak (cfs)	Standard Error (%)	Peak (cfs)	Difference (%)
Allen Creek at UGB	2	178	44	198	-10
	10	332	44	325	2
	25	418	46	412	1
	100	550	51	561	-2
Fruitdale Creek at UGB	2	241	44	230	5
	10	453	44	386	17
	25	571	46	498	15
	100	755	51	678	11

cfs = cubic feet per second; USGS = United States Geological Survey.

5.4.4 Skunk Creek and Jones Creek Basins

The procedure used for calibrating the Skunk Creek and Jones Creek basin runoff models was similar to the Sand Creek analysis whereby XP-SWMM was iteratively run and input parameters refined to minimize the difference between the measured and simulated streamflows. USGS streamflow measurements were available for

Jones Creek (USGS# 14361300) between 1951 and 1977. Skunk Creek, on the other hand, does not have any peak flow records and the datasets recently collected by the Rogue Valley Council of Governments (RVCOG) in the surrounding streams do not cover a sufficiently long period of record. Consequently, for the Jones Creek basin, a direct comparison of peak flow results was made to the USGS stream flow statistics. Due to the high level of urbanization in the Skunk Creek basin and the complex network of canals that redistribute flows, a direct comparison of runoff was not performed. Instead, the model results were compared to anecdotal evidence of flooded areas at various locations within the basin to better ensure the model's ability to reproduce known flooding problems.

5.4.4.1 Calibration Results

Results from the calibration process, shown in Tables 5.4-6 and 5.4-7, indicate that the final inputs to the hydrologic/hydraulic model are able to accurately reproduce the peak runoff response in the watershed. This information is also presented on Figure 5.4-5. For return periods between 25- and 100-yr, the difference between the model predictions and both the Jones Creek flow statistics and the regional regression predictions vary by less than 10%. However, during the smaller 2-year event, the difference is somewhat greater (20% for the Jones Creek basin).

TABLE 5.4-6
Summary of Calibration Results (USGS Gauge Comparison)
Grants Pass: Skunk Creek and Jones Creek Basins

Location	Return Period (yr)	Jones Creek USGS Gauge	Model Results	
		Peak (cfs)	Peak (cfs)	Difference (%)
Jones Creek at I-5	2	299	364	22
	10	708	701	-1
	25	963	951	-1
	100	1403	1300	-7

cfs = cubic feet per second; USGS = United States Geological Survey.

TABLE 5.4-7
Summary of Calibration Results (USGS Regional Regression method)
Grants Pass: Skunk Creek and Jones Creek Basins

Location	Return Period (yr)	USGS Regional Regression	Model Results	
		Peak (cfs)	Peak (cfs)	Difference (%)
Jones Creek at I-5	2	443	364	-18
	10	844	701	-17
	25	1070	951	-11
	100	1430	1300	-9

cfs = cubic feet per second; USGS = United States Geological Survey.

In the Skunk Creek basin, three areas were identified as known flooding problems based on discussions with City staff and the Galli Report (*Surface Water Management Study, GPID Irrigation Canals, Northeast Grants Pass, Oregon, 1995*): 1) the Mill Street Channel, 2) the Overlook Avenue area and the 3) Croxton Avenue open channel reach. In each case, the XP-SWMM model was able to reproduce channel and conveyance system flooding as generally described by city staff and the Galli Report. This confidence in the correlation between known flooding locations and model results further indicates the hydraulic models ability to simulate the peak runoff response in the watershed.

SECTION 6

Water Quality Model Development

A second key element in the master planning process is the development of a representative water quality model for the storm drain system that is capable of analyzing a variety of different water quality constituents. For these purposes, a water quality model was built to predict pollutant concentrations and the loads for the primary conveyance system in Grants Pass using a water quality design storm (approximately 1/3 of the 2-year event, or 0.93” in 24 hours). The model simulation provides approximate concentrations throughout the system to identify potential pollutant “hot spots” within the basins where regional water quality improvements would be most beneficial.

6.1.1 Model Setup

For master planning, it is desirable to know specific pollutant runoff concentrations associated with individual land use categories within the watershed being studied. In practice, this requires significant long-term data collection and analysis. Instead, because pollutants generally know no political boundaries, regionally developed guidance can be used. Event mean concentration (EMC) values provide the means to model land use-based water quality constituents in XP-SWMM. EMC values were determined for residential, commercial, transportation, open space, and industrial land use categories by reviewing the Analysis of Oregon Urban Water Quality Monitoring Data (ACWA, 1997), Table 6.1-1.

TABLE 6.1-1
Event Mean Concentration (EMC) Values Used in the Water Quality Analysis
Grants Pass: SWFMP

Water Quality Constituent	Residential	Commercial	Transportation	Open	Industrial
Total Suspended Solids (mg/L)	36.8	92.0	150.0	58.0	194.0
Phosphorus (mg/L)	0.365	0.391	0.376	0.166	0.633
Lead (mg/L)	0.020	0.009	0.008	0.004	0.009
Copper (mg/L)	0.010	0.032	0.028	0.004	0.053
Zinc (mg/L)	0.045	0.089	0.197	0.025	0.251

Source: Analysis of Oregon Water Quality Monitoring Data (ACWA, 1997); mg/L = milligrams per liter.

To incorporate these parameters into XP-SWMM, the percentage of each land use category was determined using GIS for each individual subbasin. This breakdown, in addition to the above mentioned table, was then input into XP-SWMM and the model itself determined the corresponding net pollutant concentration for each subbasin.

6.1.2 Modeled Pollutants

The primary goal of the water quality model development and analysis was to identify areas within the basin having elevated pollutant concentrations and/or loads. The water quality model is not intended to determine numerical limits to be used in NPDES permitting activities. It is also important to note that a number of the pollutants on the Oregon Department of Environmental Quality's (DEQ) 303d list cannot be readily analyzed using standard stormwater modeling tools. For example, stream temperature is strongly related to shading and tree cover along the channel and bacteria can be influenced by agricultural practices or septic tank leakage, both of which are difficult to quantify with standard modeling tools. The stormwater quality analysis modeled five water quality constituents: total suspended solids (TSS), phosphorus (P), and three metals - lead (Pb), copper (Cu) and zinc (Zn).

6.1.2.1 Total Suspended Solids

Total Suspended Solids (TSS) represents the amount of suspended organic and inorganic matter in the runoff. It includes all sediments and other constituents that are attached to the sediments or suspended in the water column itself. TSS is also a frequently reported parameter as a surrogate for other stormwater pollutants, including metals, nutrients, and various organic compounds.

Concentrations of 80 milligrams per liter (mg/L) have been found to reduce the density of macro-invertebrates by 60 percent (EPA, 1986). Researchers have also found that juvenile salmonids tend to avoid stream reaches with TSS concentrations greater than 25 milligrams per liter (mg/L) and have low population densities in reaches with TSS concentrations above 61 mg/L (DEQ, 2002). A TSS "limit" of 80 mg/L was selected to represent the upper end of concentrations that can adversely affect habitat quality. This concentration was selected based on research information summarized above, but does not represent a state criterion.

6.1.2.2 Phosphorus

Phosphorus (P) is a relatively common element that is found uniformly throughout land uses as it is widely used in fertilizers and pesticides and as a cleanser. Phosphorus is also found to occur naturally in soils and groundwater.

A draft TMDL is scheduled for issuance in 2006 for the Middle Rogue subbasin that includes the City of Grants Pass. Phosphorus is not a limiting factor for the Rogue River and its tributaries, therefore phosphorus is not one of the water quality constituents considered in the draft TMDL. Moreover, no state water quality standard (concentration limit) exists for phosphorus; however, there is guidance. EPA guidelines state that for the preservation of plant communities in streams that discharge into lakes, phosphorus concentration should be below 0.1 mg/L (EPA, 1986). Therefore, a "limit" of 0.1 mg/L was used to identify water quality analysis areas with "elevated" phosphorus concentrations in this study.

6.1.2.3 Metals

Metals such as Lead (Pb), Copper (Cu) and Zinc (Zn) are relatively common in urban storm runoff. Oregon has water quality standards for metals including lead, copper and zinc. The criteria are defined as acute (1-hour average concentration) and chronic (4-day average concentration). The toxicity of lead, copper, and zinc is a function of water hardness (concentration of calcium carbonate [$CaCO_3$]); as hardness increases, organism toxicity is lowered. The following list provides the acute and chronic concentrations for metals at this hardness:

- Lead 0.0052 mg/L acute and 0.0002 mg/L chronic
- Copper 0.0138 mg/L acute and 0.018 mg/L chronic
- Zinc 0.1877 mg/L acute and 0.1700 mg/L chronic

Lead is often found in paints used on older homes. Zinc is found on roadways due to its use as a galvanizing agent on automobiles and metal structures and is also used in tires and oil. Copper is a commonly used metal in electrical wires, paints, and in several automobile applications (such as brakes and wires).

6.1.2.4 Pollutant Limit Summary

Table 6.1-2 summarizes the water quality limits used to evaluate model results for Grants Pass.

TABLE 6.1-2
Modeled Water Quality Limits
Grants Pass: SWFMP

Water Quality Constituent	Concentration Limit (mg/L)
Total Suspended Solids (TSS)	80.0
Phosphorus (P)	0.1[1]
Lead (Pb)	0.082 [2]
Copper (Cu)	0.018 [2]
Zinc (Zn)	0.12 [2]

1: EPA (1986); 2: Acute concentrations (Table 20, OAR 340-41); mg/L = milligram per liter

SECTION 7
System Analysis

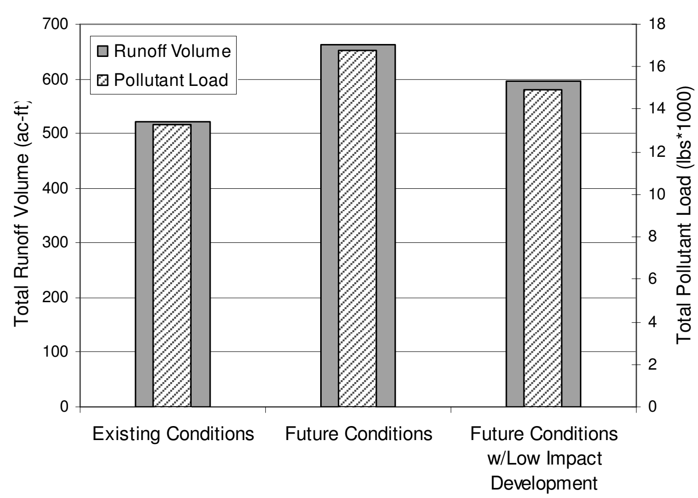
This chapter characterizes the existing and future hydraulic and water quality problem areas that will be used as a baseline for the development of a stormwater CIP program for Grants Pass.

7.1 Analysis Results

Utilizing the calibrated XP-SWMM model, runoff, hydraulic, and water quality calculations were completed for three different land use scenarios: existing conditions, future conditions and future conditions with low impact development, and two different design storms: the 25-yr event and the water quality event (1/3 of the 2-yr storm volume). The existing conditions model represents current (2005) land use conditions. The future conditions model represents a full buildout scenario (with the inclusion of Measure 37 described in Section 5.2.3.4). The future conditions with low impact development practices scenario represent full buildout with low impact development practices (i.e. on-site stormwater runoff management) being assumed for new or redeveloped parcels. All three scenarios are based on the existing conveyance system. Detailed tabular results for each scenario and each basin are located in Appendix B.

The following sections provide a basin by basin overview of the runoff, hydraulic and water quality results for the various scenarios.

7.1.1 Sand Creek Basin



Runoff results for the Sand Creek basin indicate that the area will experience a 27% increase in runoff volume due future development. This represents the largest increase in flow for any of the basins within the city. If low impact development methods are employed, the net increase would be halved to approximately 14%. Likewise, pollutants washing off of the basin follow a similar pattern, with future conditions (TSS) expected to increase by 26% and the low impact development scenario expected to increase by roughly 12%.

In order to highlight more specific and localized changes in peak flow rates and pollutant loadings between the different scenarios, 7 representative locations have been chosen for comparison as shown in Table 7.1-1, 7.1-2, and 7.1-3. From west to east, the seven locations are: (A) Sand Creek at Redwood Ave; (B) the drainage ditch along Darneille Rd north of Leonard Rd; (C) the drainage ditch at the north end of Schroeder Ln; (D) the South Main Canal at Redwood Hwy; (E) the concrete channel on Dowell Rd north of Leonard Rd; (F) the Inlet to the Wineteer Ln Pond; and (G) the Redwood Circle cul-de-sac.

TABLE 7.1-1
Summary of Selected Results: **Existing** Conditions
Grants Pass: Sand Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Sand Creek at Redwood Ave.	507.3	4.68	5729	5.34	1.04	1.39	31.4
B) Drainage ditch along Darneille Rd north of Leonard Rd	68.3	2.62	785	0.84	0.15	0.18	4
C) Drainage ditch at the north end of Schroeder Ln	97.0	4.17	1147	1.23	0.23	0.3	6.5
D) South Main Canal at Redwood Hwy	65.4	1.84	432	0.51	0.1	0.12	2.6
E) Concrete channel on Dowell Rd north of Leonard Rd	31.6	3.58	643	0.71	0.16	0.08	2.6
F) Inlet to the Wineteer Ln Pond	35.1	2.49	535	0.52	0.13	0.05	2
G) Redwood Circle cul-de-sac	22.1	7.34	337	0.33	0.09	0.03	1.2

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

TABLE 7.1-2
Summary of Selected Results: **Future** Conditions
Grants Pass: Sand Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Sand Creek at Redwood Ave.	556.4	4.65	6918	7.24	1.49	2.06	43.8
B) Drainage ditch along Darneille Rd north of Leonard Rd	101.6	2.92	1277	1.61	0.3	0.44	8.9
C) Drainage ditch at the north end of Schroeder Ln	130.1	4.49	1846	2.29	0.45	0.63	12.8
D) South Main Canal at Redwood Hwy	68.2	1.84	545	0.64	0.13	0.15	3.3
E) Concrete channel on Dowell Rd north of Leonard Rd	38.7	3.63	744	0.84	0.21	0.13	3.5
F) Inlet to the Wineteer Ln Pond	44.1	2.62	828	0.87	0.26	0.08	3.3
G) Redwood Circle cul-de-sac	26.1	8.59	475	0.5	0.15	0.04	1.8

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

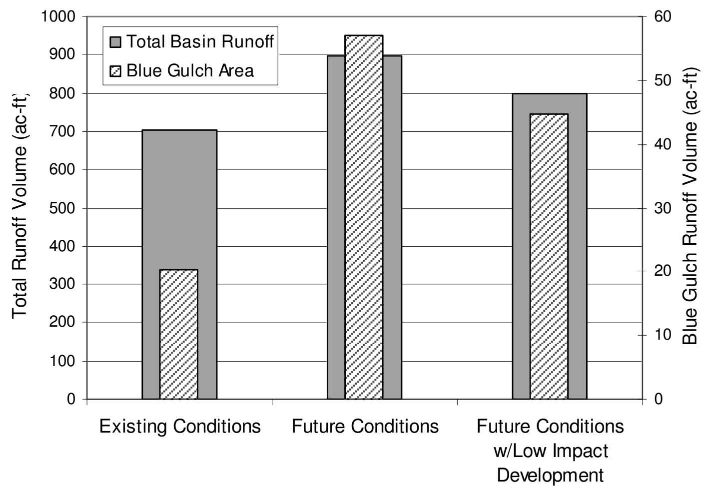
TABLE 7.1-3
Summary of Selected Results: **Future** Conditions w/**Low Impact Development**
Grants Pass: Sand Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Sand Creek at Redwood Ave.	534.1	4.66	6218	6.48	1.33	1.86	39.5
B) Drainage ditch along Darneille Rd north of Leonard Rd	92.6	2.82	1035	1.30	0.25	0.35	7.1
C) Drainage ditch at the north end of Schroeder Ln	115.0	4.30	1467	1.82	0.36	0.50	10.2
D) South Main Canal at Redwood Hwy	65.9	1.84	425	0.50	0.10	0.12	2.6
E) Concrete channel on Dowell Rd north of Leonard Rd	33.9	3.61	648	0.73	0.18	0.10	3.0
F) Inlet to the Wineteer Ln Pond	40.9	2.57	742	0.78	0.23	0.07	3.0
G) Redwood Circle cul-de-sac	25.0	8.24	440	0.46	0.14	0.04	1.7

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

One of the most prominent trends illustrated in the tabular results is the increase in peak flows between existing and future conditions throughout the basin. For example, the Darneille Road storm drain is expected to experience nearly a 50% increase in peak flow. Likewise, the ditch along the north end of Schroeder Lane is expected to have an increase of nearly 35% increase. This is a direct result of the expected new development within the basin and highlights the need to provide future conveyance or on-site flow control within the basin through system upgrades, replacements and maintenance.

7.1.2 Gilbert Creek Basin



Runoff results for the Gilbert Creek basin indicate that this portion of the city will experience a 27% increase in runoff volume due future development. If low impact development methods are employed, the net increase would be more than halved to approximately 13%. The Blue Gulch area, which is the portion of the city that is most likely to develop in the near term, is expected to experience a total increase in runoff of 182% under future conditions. If low impact development practices are used, runoff from the basin would be reduced by approximately 12 ac-ft, or nearly 25%.

In order to draw attention to specific changes in peak flow rates and pollutant loadings between the different scenarios, 7 representative locations have been chosen for comparison as shown in Table 7.1-4, 7.1-5 and 7.1-6. From upstream to downstream, the seven locations are: (A) Gilbert Creek at Morgan Ln; (B) Gilbert Creek at Manzanita Ave; (C) Gilbert Creek at the Central Oregon and Pacific Railroad bridge; (D) Gilbert Creek at the Rogue River; (E) the outfall of the existing 42” conduit on Lincoln Rd; (F) the outfall of the existing 36” conduit on Greenwood Ave; (G) the outfall of the existing 48” conduit on 8th Street; and (H) the Blue Gulch area at “B” Street.

TABLE 7.1-4
Summary of Selected Results: **Existing** Conditions
Grants Pass: Gilbert Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Gilbert Creek at Morgan Ln	714.0	8.37	5719	5.64	1.09	0.75	22.78
B) Gilbert Creek at Manzanita Ave	882.0	6.20	7952	8.05	1.64	1.10	32.68
C) Gilbert Creek at the Central Oregon and Pacific Railroad bridge	1026.2	8.78	8985	9.22	1.84	1.32	37.82
D) Gilbert Creek at the Rogue River	1076.1	10.83	10648	11.23	2.20	1.55	44.42
E) Outfall of the existing 42” conduit on Lincoln Rd	95.9	10.04	910	0.97	0.19	0.19	4.51
F) Outfall of the existing 36” conduit on Greenwood Ave	77.9	11.58	968	1.19	0.20	0.18	4.49
G) Outfall of the existing 48” conduit on 8th Street	40.9	9.24	434	0.49	0.11	0.04	1.50
H) Blue Gulch at “B” Street	58.5	5.19	81	0.07	0.01	0.02	0.42

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

TABLE 7.1-5
Summary of Selected Results: **Future** Conditions
Grants Pass: Gilbert Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Gilbert Creek at Morgan Ln	828.9	8.72	6190	6.81	1.37	1.32	32.11
B) Gilbert Creek at Manzanita Ave	1025.2	6.49	8489	9.55	1.95	1.82	44.24
C) Gilbert Creek at the Central Oregon and Pacific Railroad bridge	1221.8	9.00	9817	11.24	2.25	2.20	52.09
D) Gilbert Creek at the Rogue River	1219.2	11.25	11802	13.74	2.71	2.49	60.40
E) Outfall of the existing 42” conduit on Lincoln Rd	120.6	12.51	1146	1.39	0.29	0.31	6.81
F) Outfall of the existing 36” conduit on Greenwood Ave	103.5	14.54	1204	1.53	0.27	0.27	6.20
G) Outfall of the existing 48” conduit on 8th Street	45.3	9.44	491	0.57	0.13	0.05	1.77
H) Blue Gulch at “B” Street	157.2	7.28	102	0.13	0.03	0.04	0.83

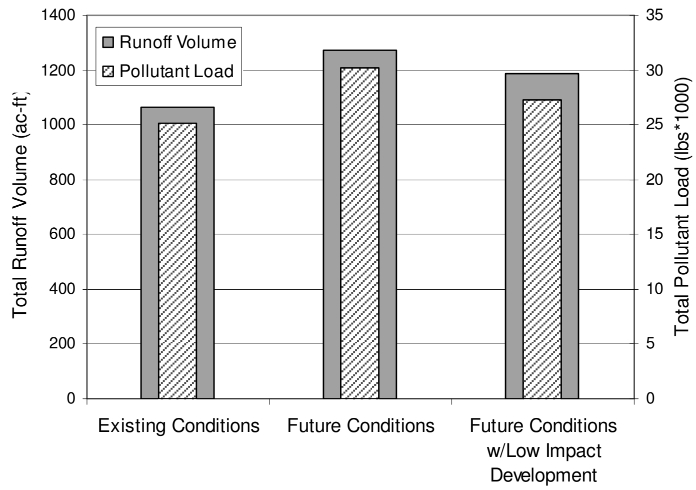
TABLE 7.1-6
Summary of Selected Results: **Future** Conditions w/**Low Impact Development**
Grants Pass: Gilbert Creek Basin

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Gilbert Creek at Morgan Ln	787.7	8.61	5693	6.27	1.26	1.19	29.15
B) Gilbert Creek at Manzanita Ave	963.7	6.36	7804	8.78	1.80	1.64	40.18
C) Gilbert Creek at the Central Oregon and Pacific Railroad bridge	1140.1	8.95	8890	10.17	2.04	1.95	46.61
D) Gilbert Creek at the Rogue River	1145.8	11.05	10651	12.38	2.45	2.20	53.94
E) Outfall of the existing 42" conduit on Lincoln Rd	108.1	11.25	978	1.19	0.25	0.26	5.85
F) Outfall of the existing 36" conduit on Greenwood Ave	83.3	11.57	988	1.26	0.22	0.22	5.03
G) Outfall of the existing 48" conduit on 8th Street	42.9	9.34	461	0.53	0.12	0.04	1.65
H) Blue Gulch at "B" Street	125.9	6.13	90	0.11	0.02	0.04	0.74

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

In contrast to the Sand Creek basin where new development is broadly increasing runoff in the existing storm drain system, impacts in the Gilbert Creek basin are more localized. Peak flows in the Blue Gulch area, for example, are expected to more than double while flows discharging via the 42" outfall along Lincoln Road are only expected to increase by roughly 10%. Because much of the new development within the Gilbert Creek basin is anticipated to occur in the upper portion of the watershed, substantial changes to flows along Gilbert Creek were not predicted in the model. This is because the localized increases in runoff due to development are progressively diminished in the downstream direction as more flows enter the creek.

7.1.3 Allen Creek and Fruitdale Creek Basins



Runoff results for the Allen Creek and Fruitdale Creek basins indicate that this portion of the city will experience a 20% increase in runoff due future development. If low impact development methods are employed, the net increase would be reduced to roughly 12%. Likewise, pollutants washing off of the basin follow a similar pattern, with future conditions (TSS) expected to increase by 20% and the low impact development scenario expected to increase by 9%.

To emphasize specific differences in peak flow rates and pollutant loadings among the different scenarios, the following seven representative locations have been selected for comparison as indicated in Tables 7.1-7, 7.1-8 and 7.1-9. From upstream to downstream, the seven locations are: (A) Allen Creek at New Hope Road; (B) Allen Creek at Ramsey Avenue; (C) Allen Creek at Redwood Highway; (D) Fruitdale Creek at Hamilton Lane; (E) Fruitdale Creek at the Rogue River Highway; (F) the outfall of the existing 48” conduit flowing North on Parkdale Drive; and (G) the outfall of the existing 48” conduit at the 7th Street Bridge.

TABLE 7.1-7
Summary of Selected Results: **Existing** Conditions
Grants Pass: Allen and Fruitdale Creek Basins

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Allen Creek at New Hope Rd	548	7.0	5534.3	4.86	0.921	1.3	29.46
B) Allen Creek at Ramsey Ave	680	4.9	8666.2	8.08	1.636	1.927	45.2
C) Allen Creek at Redwood Hwy	725	8.7	9226.6	8.67	1.771	1.979	47.23
D) Fruitdale Creek at Hamilton Ln	748	6.7	5429.8	3.85	0.709	1.013	24.98
E) Fruitdale Creek at the Rogue River Hwy	783	9.2	6088.7	4.5	0.826	1.129	27.93
F) Outfall of the existing 48" pipe flowing North on Parkdale Dr	74	15.4	1195	1.31	0.271	0.244	6.01
G) Outfall of the existing 48" conduit at the 7th Street Bridge	105	22.6	1330	1.52	0.296	0.163	5.07

1. 25-yr design storm

2. 1/3 of the 2-yr storm (water quality event)

TABLE 7.1-8
Summary of Selected Results: **Future** Conditions
Grants Pass: Allen and Fruitdale Creek Basins

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Allen Creek at New Hope Rd	711	7.4	6922.3	7.59	1.53	2.491	49.69
B) Allen Creek at Ramsey Ave	869	5.1	10593.4	11.82	2.443	3.473	71.64
C) Allen Creek at Redwood Hwy	920	9.4	11377.7	12.67	2.68	3.538	74.55
D) Fruitdale Creek at Hamilton Ln	1,058	7.2	7205.7	6.53	1.298	2.164	45.32
E) Fruitdale Creek at the Rogue River Hwy	1,125	10.1	8076.7	7.62	1.515	2.423	50.83
F) Outfall of the existing 48" pipe flowing North on Parkdale Dr	85	16.2	1302.9	1.58	0.33	0.364	7.96
G) Outfall of the existing 48" conduit at the 7th Street Bridge	123	23.5	1665	1.98	0.417	0.229	6.86

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

TABLE 7.1-9
Summary of Selected Results: **Future** Conditions w/**Low Impact Development**
Grants Pass: Allen and Fruitdale Creek Basins

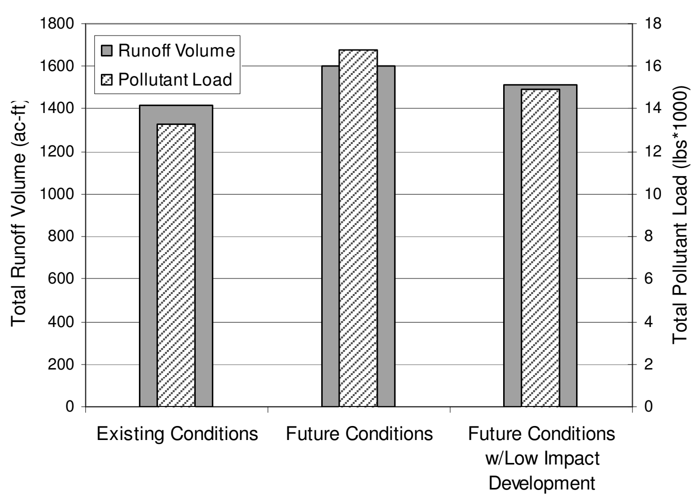
Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Allen Creek at New Hope Rd	658	7.2	6305.5	6.89	1.385	2.242	44.86
B) Allen Creek at Ramsey Ave	805	5.0	9723.5	10.82	2.234	3.16	65.33
C) Allen Creek at Redwood Hwy	854	9.2	10433.8	11.59	2.447	3.22	67.98
D) Fruitdale Creek at Hamilton Ln	954	7.1	6480.8	5.88	1.17	1.953	40.86
E) Fruitdale Creek at the Rogue River Hwy	1,023	9.9	7265.8	6.86	1.364	2.188	45.85
F) Outfall of the existing 48" pipe flowing North on Parkdale Dr	81	15.9	1219.8	1.48	0.308	0.342	7.47
G) Outfall of the existing 48" conduit at the 7th Street Bridge	113	23.0	1516.5	1.8	0.381	0.203	6.18

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

The tabular results generally indicate that peak flows and pollutant loads in the Fruitdale Creek Basin are expected to increase more than those in the Allen Creek Basin. For example, peak flows in Allen Creek at Redwood Highway are expected to increase by 18% (approximately 130 cfs) while peak flows in Fruitdale Creek at the Rogue River Highway are expected in increase by more than 30% (roughly 240 cfs).

7.1.4 Skunk Creek and Jones Creek Basins

Runoff results for the Skunk Creek and Jones Creek basins indicate that this portion of the city will experience the smallest increase in runoff from new development at 13%. If low impact development methods are employed, the net increase would roughly be halved to 7%. Likewise, pollutants washing off of the basin follow a similar pattern, with future conditions (TSS) expected to increase by 20% and



the low impact development scenario expected to increase by 9%.

To highlight specific changes in peak flow rates and pollutant loadings among the different scenarios, eight representative locations have been chosen for comparison as shown in Tables 7.1-10, 7.1-11 and 7.1-12. From upstream to downstream, the seven locations are: (A) Skunk Creek at the Rogue River; (B) Skunk Creek at “C” Street; (C) Skunk Creek between Evelyn Avenue and Manzanita Avenue; (D) the Mill Street Channel upstream of Grants Pass Parkway; (E) the 48” storm drain downstream of the “E” Street and “F” Street Intersection; (F) the open channel immediately east of Croxton Street; (G) the 48” storm drain at the intersection of the Southern Oregon and Pacific Railroad and Grants Pass Parkway; and (H) Jones Creek at the Southern Oregon and Pacific Railroad bridge.

TABLE 7.1-10
Summary of Selected Results: **Existing** Conditions
Grants Pass: Skunk and Jones Creek Basins

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Skunk Creek at the Rogue River	674.3	18.5	17,470	19.87	4.21	1.91	66.9
B) Skunk Creek at “C” Street	178.9	3.5	3,080	3.29	0.75	0.45	13.2
C) Skunk Creek between Evelyn Avenue and Manzanita Avenue	110.9	18.1	1,662	1.69	0.40	0.23	6.9
D) the Mill Street Channel upstream of Grants Pass Parkway	228.3	0.8	5,284	5.92	1.25	0.80	23.0
E) the 48” storm drain downstream of the “E” Street and “F” Street junction	122.9	9.7	2,112	2.36	0.49	0.41	10.4
F) the open channel immediately east of Croxton Street	99.9	4.7	1,056	1.11	0.19	0.15	4.1
G) the 48” storm drain at the SO&P RR and Grants Pass Parkway	90.8	7.1	4,668	5.25	1.10	0.35	15.7
H) Jones Creek at the Southern Oregon and Pacific Railroad bridge	991.8	24.3	7,210	5.36	1.02	0.76	25.7

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

TABLE 7.1-11
Summary of Selected Results: **Future** Conditions
Grants Pass: Skunk and Jones Creek Basins

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Skunk Creek at the Rogue River	710.9	18.8	19,160	22.69	4.94	2.70	82.5
B) Skunk Creek at “C” Street	187.1	3.5	3,702	4.21	0.96	0.68	18.0
C) Skunk Creek between Evelyn Avenue and Manzanita Avenue	124.6	18.4	5,750	6.92	1.39	1.14	28.7
D) the Mill Street Channel upstream of Grants Pass Parkway	242.4	0.8	2,429	2.88	0.59	0.57	13.2
E) the 48” storm drain downstream of the “E” Street and “F” Street junction	135.8	10.6	1,118	1.31	0.22	0.23	5.4
F) the open channel immediately east of Croxton Street	101.8	4.7	5,634	6.66	1.49	0.51	20.7
G) the 48” storm drain at the SO&P RR and Grants Pass Parkway	96.8	7.5	10,015	7.56	1.47	1.31	39.2
H) Jones Creek at the Southern Oregon and Pacific Railroad bridge	1294.4	26.6	2,481	2.79	0.63	0.47	12.3

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

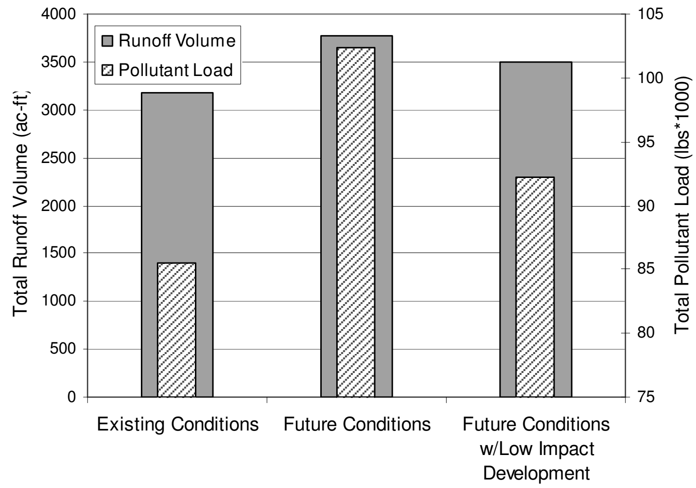
TABLE 7.1-12
Summary of Selected Results: **Future** Conditions w/**Low Impact Development**
Grants Pass: Skunk and Jones Creek Basins

Location	Peak Flow (cfs)[1]	Max Velocity (ft/s)[1]	Pollutant Load (lbs)[2]				
			TSS	Zn	Cu	Pb	P
A) Skunk Creek at the Rogue River	686.4	18.6	17,693	20.94	4.57	2.43	75.4
B) Skunk Creek at “C” Street	181.0	3.5	3,283	3.72	0.85	0.59	15.8
C) Skunk Creek between Evelyn Avenue and Manzanita Avenue	116.6	18.2	2,192	2.46	0.56	0.40	10.7
D) the Mill Street Channel upstream of Grants Pass Parkway	233.8	0.8	5,329	6.41	1.29	1.03	26.2
E) the 48” storm drain downstream of the “E” Street and “F” Street junction	128.3	10.1	2,205	2.61	0.54	0.51	11.9
F) the open channel immediately east of Croxton Street	101.3	4.7	1,057	1.24	0.21	0.21	5.1
G) the 48” storm drain at the SO&P RR and Grants Pass Parkway	94.3	7.3	5,228	6.17	1.38	0.48	19.2
H) Jones Creek at the Southern Oregon and Pacific Railroad bridge	1179.8	25.7	8,959	6.87	1.34	1.17	35.1

1. 25-yr design storm
2. 1/3 of the 2-yr storm (water quality event)

As indicated in the tabular data, minimal increases in peak flows and pollutant loadings are predicted throughout the Skunk Creek Basin. For all locations listed above, peak flows increased by a maximum of 12% over existing conditions. Likewise, low impact development offered very modest benefits in terms of reducing pollutant loadings and peak flows. This trend indicates that the basin is approaching its full buildout condition, thus limiting future development and the effectiveness of low impact development.

7.1.5 Low Impact Development Summary



City-wide, low impact development practices have a relatively significant impact on reducing runoff and pollutants generated from new development. Collectively, new development within the UGB is expected in increase the total runoff volume by nearly 600 ac-ft. If low impact development practices are adopted, the net runoff increase will be reduce by nearly 50% to 320 ac-ft. Even with this level of reduction, low impact development techniques do not fully mitigate for development, nor do they solve existing system deficiencies. Consequently, it is recommended that low impact development techniques be used to the maximum extent practical to minimize the need for additional stormwater management facilities to manage growth. General improvements to the existing system along with new facility construction are still required to provide full stormwater quantity and quality management.

7.2 Problem Identification Criteria

System deficiencies can be categorized as either water quantity or water quality related. Water quantity, or hydraulic, deficiencies are generally related to an undersized or poorly designed conveyance system. However, hydraulic deficiencies can also result from insufficient system storage or excessive runoff generated from highly impervious land cover. In addition to hydraulic deficiencies, areas with excessive pollutant concentrations and/or loads also can be classified as deficient from a water quality perspective.

To identify deficiencies for both categories, results from the XP-SWMM model were evaluated against the planning and analysis criteria, which are presented in Section 3. These criteria include:

- Storm Drain Surcharging
- Channel Flooding
- Culvert Crossings
- Water Quality Areas of Concern

7.3 System Deficiency Summary

As previously mentioned, specific problem areas were identified for existing land use by evaluating each system node (manhole or conveyance system junction) and link (pipe, channel, canal, etc.) using the noted hydraulic and water quality criteria. For the existing land use scenario, these areas represent current system deficiencies and are unrelated to future urbanization. Future condition problems summarized in this section are based on the Future Land Use with Low Impact Development scenario. For the future condition, the additional (or expanded) problem areas represent locations where runoff from new development is likely to exceed the capacity of the existing system.

The following sections describe these system deficiencies basin by basin. In most cases, a number of deficient nodes and links have been grouped together into a single problem area. For example, an undersized pipe segment may cause several upstream manholes to surcharge and flood; hence the problem area encompasses the undersized pipe as well as the flooded nodes and adjacent pipes. Additionally, for each basin, the cause of the problem, the impacts resulting from the problem, and opportunities for addressing each problem area, are presented in a tabular format along with key technical information specific to each problem area.

7.3.1 Sand Creek Basin - Existing Deficiencies

7.3.1.1 Storm Drain Surcharging

Storm drain surcharging areas are shown in Appendix G-1 and are summarized in Table 4.5-4. System modeling identified 34 storm drain manholes that exceed the surcharging criteria. Moreover, 21 of the 34 drainage nodes also produce adjacent surface/street flooding. In terms of general problem locations, these storm drain deficiencies are primarily focused in five areas:

1) the South Main Canal between Willow Ln and Redwood Hwy,

2) the Yellowtail Ln / Kokanee Ln area,

3) the drainage system along Leonard Rd between Angler Ln and Parkhill Place,

4) the storm drain along Dowell Rd and Sun Glo Dr, and

5) the storm drain along Redwood Circle.

The remaining system deficiencies are not grouped in any way and are simply a result of a localized hydraulic restriction.

7.3.1.2 Channel Flooding

Because much of the primary drainage system within the UGB consists of a piped network, major open channel flooding problems were not encountered. However, two open channel segments were identified as producing surface flooding (Appendix G-1 and Table 7.3-1): 1) the concrete ditch at the north end of Dowell Rd adjacent to the mobile home park and 2) the South Main Canal between Medart Ln and Redwood Hwy. For both cases, the channel flooding is a direct result of under capacity pipes immediately downstream.

7.3.1.3 Culvert Crossings

System modeling identified two culvert problem locations as experiencing overtopping or road subgrade inundation under existing conditions, Appendix G-1. They are; 1) the Sand Creek culvert under Redwood Avenue and 2) the Leonard Road culvert immediately west of Dinkle Lane. Elmer Nelson Road also experiences culvert flooding.

7.3.1.4 Water Quality Areas of Concern

Several pollutants including phosphorus and lead produce elevated concentrations throughout the basin. Other pollutants, such as zinc and total suspended solids, are generally at or below the project water quality criteria limits. Key water quality areas of concern include (Appendix G-2); 1) Dowell Rd north of Redwood Hwy, 2) Wineteer Ln north of Redwood Ave and 3) Redwood Circle. Concentrations of all pollutants are elevated in these areas, as well as several other localized segments within the basin, because a majority of the contributing drainage areas are made up of commercial or industrial land developments and roads, which typically generate the highest pollutant concentrations and loads.

7.3.2 Sand Creek Basin - Future Deficiencies

7.3.2.1 Storm Drain Surcharging

Future storm drain problem areas are shown in Appendix G-3 and are summarized in Tables 7.3-1 and 7.3-5. System modeling identified 56 storm drain manholes that exceed the surcharging criteria. This is 22 additional locations, or a 65% increase from existing conditions Moreover, 42 of the 56 drainage nodes also produce adjacent surface flooding; up from 21 under existing conditions. In terms of problem identification, the same problem areas that are present for existing land use scenarios are also deficient for the future conditions scenario. However, several new problem areas were also identified under future land use. They are; 1) George Tweed and Eastwood Ln south of Redwood Ave, 2) Darneille Ln between Redwood Ave and Leonard Rd. and 3) Willow Ln immediately south of Leonard Rd.

7.3.2.2 Channel Flooding

As with the existing conditions analysis, two open channel segments have flooding problems (Appendix G-3): 1) North Dowell Rd adjacent to the mobile home park and 2) the South Main Canal between Medart Ln and Redwood Hwy. For both cases, the depth and duration of flooding increase as compared to existing conditions; however, they continue to be a direct result of an under capacity pipe system immediately downstream.

7.3.2.3 Culvert Crossings

System modeling identified four culvert problem locations experiencing overtopping or road subgrade inundation (Appendix G-3). In addition to the two culverts identified during the existing conditions analysis, future condition problem locations are 1) the Sand Creek culvert at Demaray Dr and 2) the Coutant Ln culvert.

7.3.2.4 Water Quality Areas of Concern

Drainage segments with elevated pollutant concentrations, or “hot spots”, are generally located in the same areas as existing conditions (Appendix H). Although future conditions represent full build-out of the basin, much of the new development in the Sand Creek basin consists of low and medium density residential, which does not generate high pollutant loads and concentrations for the modeled pollutants. Additionally, the industrial and commercial land uses are located in the same areas today as under the future conditions scenario, Redwood Circle and Wineteer Ln between Redwood Highway and Avenue, and therefore major changes in peak pollutant concentrations are not evident.

In terms of the quantity of pollutants, the future conditions scenario produces significantly higher total loads as seen in Appendix G-4. Although concentration “hot spots” are not present in each drainage reach, the increased urbanization results in higher loads for almost every drainage segment. Consequently, water quality treatment facilities that address increased pollutant loads have been considered for each storm drain sub-region.

7.3.3 Sand Creek Basin - Problem Locations

Existing and future condition problem locations are shown on Figure 7.3-1. The cause of the problem, the impacts resulting from the problem, and opportunities for addressing each problem area, are summarized below in Table 7.3-1.

TABLE 7.3-1
Existing and Future Condition Problem Locations
Grants Pass: Sand Creek Basin

Problem Location	Problem Description
SA-1	• **Cause:** Existing water quality pond not performing adequately. • **Impacts:** Untreated runoff is entering South Main Canal and ultimately Sand Creek. • **Opportunities:** Retrofit, replace or relocated the existing water quality pond to maximize the water quality treatment and detention. Alleviate flooding potential along the South Main Canal near Sand Creek.
SA-2	• **Cause:** Undersized storm drain pipe between Redwood Ave. and Redwood Circle cul-de-sac. • **Impacts:** Localized street flooding and manhole surcharging. • **Opportunities:** Upsize the storm drain to accommodate larger flows.
SA-2A	• **Cause:** Insufficient drainage capacity resulting in localized flooding. • **Impacts:** Neighborhood ditch flooding along Redwood Ave. • **Opportunities:** Construct a new 24” storm drain along Redwood Ave.
SA-3	• **Cause:** Under capacity storm drain system beneath the Redwood Heights Subdivision. • **Impacts:** Localized flooding on streets and in upstream along the South Main Canal. • **Opportunities:** Several alternatives exist for this problem including construction of a diversion structure and bypass system.
SA-4	• **Cause:** Undersized storm drains. • **Impacts:** Untreated industrial and commercial runoff is directly entering the Rogue River; street flooding. • **Opportunities:** Upsize the storm drain and divert industrial and commercial runoff to a structural pollution reduction facility or the South Downs Estates ponds, additional runoff conveyed to surface facilities.

TABLE 7.3-1
Existing and Future Condition Problem Locations
Grants Pass: Sand Creek Basin

Problem Location	Problem Description
SA-4A	• **Cause:** Lack of treatment for industrial and commercial runoff. • **Impacts:** Untreated runoff draining to South Downs Estates ponds. • **Opportunities:** Several opportunities exist including modifying the current channel into a water quality swale to provide some treatment or divert runoff into a proprietary pollution reduction facility targeting sediment removal.
SA-5	• **Cause:** Undersized pipe on Dowell Road. • **Impacts:** Insufficient drainage resulting in localized street flooding. • **Opportunities:** Install a parallel pipe to alleviate the capacity issue.
SA-5A	• **Cause:** No water quality treatment. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Construct a water quality swale along existing channel or install a new outlet pipe and a proprietary pollution reduction facility.
SA-6	• **Cause:** Insufficient drainage capacity. • **Impacts:** Street flooding and manhole surcharging. • **Opportunities:** Several opportunities exist including upsizing the pipe and construction of a detention/water quality facility.
SA-7	• **Cause:** Undersized culvert and under capacity drainage channel. • **Impacts:** Surface flooding along Leonard Road. • **Opportunities:** Replace existing culvert and increase downstream channel capacity through channel improvements.
SA-8	• **Cause:** Partially completed storm drain system. • **Impacts:** Significant surcharging and flooding. • **Opportunities:** Install a new storm drain pipe system.
SA-9	• **Cause:** Insufficient culvert capacity. • **Impacts:** Roadway overtopping. • **Opportunities:** Upsize the existing culvert.

TABLE 7.3-1
Existing and Future Condition Problem Locations
Grants Pass: Sand Creek Basin

Problem Location	Problem Description
SA-10	• **Cause:** Insufficient drainage capacity. • **Impacts:** Significant surcharging and flooding throughout the neighborhood residential subdivisions. • **Opportunities:** Several opportunities exist including upsizing the existing storm drain pipe and possibly constructing a stormwater detention and water quality facility, and upsizing the pipe and diverting runoff to the nearby wetland via a water quality swale.
SA-11	• **Cause:** Insufficient culvert capacity. • **Impacts:** Roadway overtopping. • **Opportunities:** Upsize the existing culvert.
SA-12	• **Cause:** Insufficient culvert capacity. • **Impacts:** Roadway overtopping and adjacent property flooding. • **Opportunities:** Upsize the existing culvert.

7.3.4 Gilbert Creek Basin - Existing Deficiencies

7.3.4.1 Storm Drain Surcharging

Storm drain problem areas are shown in Appendix G and are summarized in Tables 7.3-2 and 7.3-6. System modeling identified 57 modeled storm drain manholes that exceed the surcharging criteria. Moreover, 51 of the 57 drainage nodes also produce adjacent surface/street flooding. In terms of general problem locations, these storm drain deficiencies are primarily focus in eight areas;

1) the south end of Lincoln Drive near the Rogue River,

2) the Greenwood Avenue conduit north of Bridge Street,

3) Oak Street north of Bridge Street,

4) the “F” Street and 4th Street Conduit,

5) the 5th Street conduit between the Rogue River and “H” Street,

6) the 9th Street conduit between “M” Street and “I” Street,

7) 7th and 8th Street north of Hillcrest and

8) the Highland Avenue and Vine Street intersection.

The remaining system deficiencies are not grouped in any way and are simply a result of localized hydraulic restrictions.

7.3.4.2 Channel Flooding

Because much of the primary drainage system within the Urban Growth Boundary (UGB) consists of a piped network, major open channel flooding problems were not encountered. However, two open channel segments were identified as producing surface flooding (Appendix G-5); 1) the open channel north and west of Grant Street and "B" Street and 2) the upper portion of Gilbert Creek within the trailer park immediately south of I-5. For the first case, channel flooding is a direct result of under capacity pipes immediately downstream. The second case is based on field observations and City maintenance records. As flooding was not predicted in the model, the relatively flat slope and heavy vegetation in the trailer park is likely limiting channel capacity.

7.3.4.3 Culvert Crossings

System modeling identified nine culvert problem locations as experiencing road subgrade inundation under existing conditions, Appendix G-5. Four of the nine culverts experience roadway overtopping. They are "E" Street, "F" Street, "I" Street and "L" Street.

7.3.4.4 Water Quality Areas of Concern

Several pollutants including phosphorus and lead produce elevated concentrations throughout the basin. Others like zinc are generally at or below the project water quality criteria limits. Key water quality areas of concern include 1) the downtown corridor south of "A" Street between 5^{th} St. and 9^{th} St. and 2) 6^{th} and 7^{th} St north of Hillcrest Ave. Concentrations of all pollutants are elevated in these areas, as well as several other localized segments within the basin, because a majority of the contributing drainage areas are made up of commercial or industrial land developments and roads, which typically generate the highest pollutant concentrations and loads. Several other areas were identified during the data collection phase of the project as potential water quality areas of concerns. They include the areas surrounding the railroad tracks and I-5 for metals and the drainage inlets at the base of the hills west of the city (west end of Morgan St for example) for sand and granite that is washed down during thunderstorms.

7.3.5 Gilbert Creek Basin - Future Deficiencies

7.3.5.1 Storm Drain Surcharging

Future storm drain problem areas are shown in Appendix G-6. System modeling identified 69 modeled storm drain manholes that exceed the surcharging criteria. Moreover, 65 of the 69 drainage nodes also produce adjacent surface flooding. In terms of problem areas in addition to those highlighted as existing problems, the storm drain system along "B" Street, which drains the Blue Gulch area, is expected to be under capacity when the basin is fully developed.

7.3.5.2 Channel Flooding

As with the two previous scenarios, the same two open channel segments are expected to have flooding problems (Appendix G-6).

7.3.5.3 Culvert Crossings

System modeling identified nine culvert problem locations as experiencing road subgrade inundation under the low impact development scenario, Appendix G-6. Under full buildout conditions, six of the nine culverts are also predicted to experience roadway overtopping.

7.3.5.4 Water Quality Areas of Concern

Generally, the same water quality areas of concern were predicted for the low impact development scenario as for the existing and full build out scenario.

7.3.6 Gilbert Creek Basin - Problem Locations

Existing and future condition problem locations are shown on Figure 7.3-2. The cause of the problem, the impacts resulting from the problem, and opportunities for addressing each problem area, are summarized below in Table 7.3-2.

TABLE 7.3-2
Existing and Future Condition Problem Locations
Grants Pass: Gilbert Creek Basin

Problem Location	Problem Description
G-1	• **Cause:** Undersized pipe system. • **Impacts:** Localized flooding and no water quality treatment for runoff entering the Rogue River. • **Opportunities:** Upsizing the system, constructing several new segments, and construction of a water quality manhole.
G-1A	• **Cause:** No water quality treatment is currently provided prior to discharge into the Rogue River. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Construct a water quality manhole at the downstream end of this system.
G-2	• **Cause:** No water quality treatment is currently provided prior to discharge into the Rogue River. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Construct a water quality manhole at the downstream end of this system.
G-3	• **Cause** No water quality treatment is currently provided prior to discharge into the Rogue River. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Construct a water quality manhole at the downstream end of this system.
G-4	• **Cause:** Flat slopes, extensive wetlands and low-profile (sage) roadway. • **Impacts:** Localized flooding and roadway overtopping. • **Opportunities:** Raise the roadway and upsize the existing culvert.
G-5	• **Cause:** Undersized pipe. • **Impacts:** Localized flooding. • **Opportunities:** Upsize pipes to accommodate full build-out scenario.
G-6	• **Cause:** Undersized pipe and high water levels in Gilbert Creek. • **Impacts:** Localized flooding. • **Opportunities:** Upsize several pipe segments to reduce flooding.
G-7	• **Cause:** Undersized pipe and high water levels in Gilbert Creek. • **Impacts:** Localized flooding and surcharging. • **Opportunities:** Upsize several pipe segments to reduce but not

TABLE 7.3-2
Existing and Future Condition Problem Locations
Grants Pass: Gilbert Creek Basin

Problem Location	Problem Description
	eliminate flooding.
G-8	• **Cause:** Pipe undersized and in poor condition. • **Impacts:** Localized flooding and surcharging. • **Opportunities:** Replace current pipe upgrading material and size.
G-9	• **Cause:** Undersized pipe. • **Impacts:** Localized flooding. • **Opportunities:** Upsize several pipe segments to reduce flooding.
G-10	• **Cause:** No water quality treatment in existing system. • **Impacts:** Heavy land use results in elevated pollution loads discharged to the Rogue River. • **Opportunities:** Construct a water quality manhole.
G-11	• **Cause:** Under capacity storm drain system and poorly designed inlet structure. • **Impacts:** Localized flooding along Grant Street and sediment accumulation along “B” Street. • **Opportunities:** Construct a small sedimentation basin/detention pond to address flooding along Grants Street.
G-12	• **Cause:** Under capacity storm drain system. • **Impacts:** Localized flooding and surcharging. • **Opportunities:** Replace the existing pipe with a larger system.
G-13	• **Cause:** No water quality treatment is existing system. • **Impacts:** Untreated runoff is entering Gilbert Creek. • **Opportunities:** Construct a water quality manhole.
G-14	• **Cause:** Lack of an existing storm drain system. • **Impacts:** Surface and roadway flooding in the vicinity of Highland Avenue and Starlite Drive. • **Opportunities:** A new storm drain system would relieve flooding.
G-14A	• **Cause:** Poorly planned stormwater outfall location along Starlite Drive. • **Impacts:** Runoff being directly down the slopes of the Blue Gulch area will cause erosion and potentially flooding in new residential developments. **Opportunities:** Construct a new storm drain system that directly connects Starlite Drive Gilbert Creek
G-14B	• **Cause:** New development will dramatically increase runoff.

TABLE 7.3-2
Existing and Future Condition Problem Locations
Grants Pass: Gilbert Creek Basin

Problem Location	Problem Description
	• **Impacts:** Erosion will likely increase and the capacity of the downstream conveyance system will be exceeded. • **Opportunities:** Construct new detention facilities in the Blue Gulch area to eliminate the need to upside the “B” Street storm drain system.
G-15	• **Cause:** No water quality treatment is existing system. • **Impacts:** Untreated runoff is entering Gilbert Creek from commercial and residential areas. • **Opportunities:** Construct two water quality manholes - one at the downstream end of each system.
G-16	• **Cause:** Under capacity and poorly maintained open channel reach within the trailer park • **Impacts:** Localized flooding of the trailer park. • **Opportunities:** Expand the capacity of the open channel.
G-17	• **Cause:** Under capacity storm drain system. • **Impacts:** Localized flooding, surcharging, and gutter flow. • **Opportunities:** Upsize storm drain system.
G-17A	• **Cause:** Lack of a storm drain system • **Impacts:** Localized flooding and gutter flow. • **Opportunities:** Construct a storm drain to connect the two existing pipe systems.
G-18	• **Cause:** Large storm events results in excessive flows peak in lower Gilbert Creek. • **Impacts:** Culverts overtopped and road subgrade inundated; channel banks steepen and possible bank failures. • **Opportunities:** Construct a regional detention facility in the vacant lot immediately downstream of I-5.
G-19	• **Cause:** Under capacity storm drain system. • **Impacts:** Localized flooding on Highland Ave. • **Opportunities:** Upsize storm drain system.

7.3.7 Allen Creek and Fruitdale Creek Basins - Existing Deficiencies

7.3.7.1 Storm Drain Surcharging

Storm drain problems are shown in Appendix G-7. System modeling identified 107 modeled storm drain manholes that exceed the surcharging criteria. Moreover, 84 of the 116 drainage nodes also produce adjacent surface/street flooding. In terms of general problem locations, these storm drain deficiencies are primarily focused in three areas;

1) Harbeck Drive from Southridge Road to Union Avenue
2) The Rogue River Highway system discharging at 7th Street outfall upstream of Grants Pass Parkway
3) The Parkdale Drive system discharging at Grants Pass Highway 48" outfall upstream of E. Park Street

The remaining system deficiencies are not grouped in any way and are simply a result of localized hydraulic restrictions.

7.3.7.2 Channel Flooding

Channel flooding in the two basins is largely limited Allen Creek between Ramsey Avenue and Redwood Highway as well as the two irrigation canals (the South Highline Canal, the South Main Canal) that flow in an east-west direction from Fruitdale Creek to Allen Creek. System modeling predicted flooding at a number of locations along the canals due to limited channel capacity and the very flat slope of the canal itself. Boundary conditions for the two canals were assumed that all flows originating east of Fruitdale Creek would be spilled into Fruitdale Creek and all runoff originating west of Fruitdale Creek would be conveyed by the canals and spill into Allen Creek.

7.3.7.3 Culvert Crossings

System modeling identified one culvert, located on Fruitdale Creek at Fruitdale Drive that is experiencing flow rates above its full-flow hydraulic capacity. The culvert entrance is surcharged but not at a level that results in subgrade or road flooding. This street crossing is also known to city staff as a problem area. Recently, it has experienced significant roadway overtopping on several occasions due to the culverts limited capacity and possible debris clogging.

7.3.7.4 Water Quality Areas of Concern

Several pollutants including phosphorus and lead produce elevated concentrations throughout the basin. Others like zinc are generally at or below the project water quality criteria limits. All the key water quality areas of concern are generally located between Allen and Fruitdale Creeks, adjacent to Redwood Highway and the Rogue River Highway. The dominant land use along this corridor is commercial with nearly all flows draining via a piped storm drain system directly to the Rogue River. Existing water quality areas of concern are shown in Appendix G-8.

7.3.8 Allen Creek and Fruitdale Creek Basins – Future Deficiencies

7.3.8.1 Storm Drain Surcharging

Future storm drain problem areas are shown in Appendix G-9. System modeling identified 120 modeled storm drain manholes that exceed the surcharging criteria. This is an increase of 13 additional locations, or an 11% increase from existing conditions Moreover, 98 of the 120 drainage nodes also produce adjacent surface flooding; up from 84 under existing conditions. In terms of problem identification, the same problem areas that are present for the existing land use scenario are also deficient for the future land use scenario. The primary difference is that the surcharging conditions are more widespread in the problem areas identified in the existing conditions scenario.

7.3.8.2 Channel Flooding

As with the existing conditions analysis, the same canal segments have flooding problems, as shown on Appendix G-9. The increased volume of runoff as a result of new impervious surface, combined with the very flat slope of the canal, generates additional flows that further exasperate the hydraulic capacity problems of the canals.

7.3.8.3 Culvert Crossings

Future conditions model results indicate that the same culvert, Fruitdale Creek at Fruitdale Drive, will experience flow rates above its full-flow hydraulic capacity.

7.3.8.4 Water Quality Areas of Concern

Drainage segments with elevated pollutant concentrations, or “hot spots,” are generally located in the same areas as existing conditions. Because the lower portion of the basins are already nearing full buildout, significant changes in the pollutant loadings were not expected, nor were they predicted by the XP-SWMM model. Refer to Appendix G-8 for the water quality areas of concern.

7.3.9 Allen Creek and Fruitdale Creek Basins - Problem Locations

Existing and future condition problem locations are shown on Figure 7.3-3. The cause of the problem, the impacts resulting from the problem, and opportunities for addressing each problem area, are summarized below in Table 7.3-3.

TABLE 7.3-3
Existing and Future Condition Problem Locations
Grants Pass: Allen Fruitdale Creek Basins

Problem Location	Problem Description
A-1	• **Cause:** The existing culverts beneath Redwood Highway are a major barrier to fish passage. • **Impacts:** Allen Creek is presently not accessible to anadromous fish. • **Opportunities:** ODOT roadway improvements in this area are currently being considered and may directly address this problem. Retrofitting the culvert for fish passage may also be possible.
A-2	• **Cause:** No water quality treatment is currently provided for the Redwood Highway corridor and surrounding commercial areas. • **Impacts:** Untreated runoff is directly entering Allen Creek and the Rogue River. • **Opportunities:** ODOT roadway improvements in this area are currently being considered and may offer a joint opportunity to provide water quality treatment for the right-of-way and surrounding commercial areas.
A-3	• **Cause:** Upland runoff not captured by the Allen Creek Lateral surcharges the existing storm drain system. • **Impacts:** Flooding is predicted in the storm drain system in the Allen Creek and Whispering Meadows subdivisions as well as the wetland areas to the immediate north.
A-4	• **Cause:** No water quality treatment is currently provided for the fairgrounds or the areas draining via the Main Canal and along River Heights Way. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Given the proximity of the storm drain systems on River Heights Way and in the fairgrounds immediately to the east, a single water quality facility could treat both areas.
A-5	• **Cause:** No water quality treatment is currently provided for the areas draining via Short Street. • **Impacts:** Untreated runoff is directly entering the Rogue River.
A-7	• **Cause:** High runoff rates and large spills from the canals results in excessive flows in lower Allen Creek. • **Impacts:** Localized creek flooding is experienced just north of Ramsey Avenue • **Opportunities:** A regional detention facility in the upper portion of the basin would provide peak flow management for the lower reaches.
F-1	• **Cause:** No water quality treatment is currently provided for the areas

TABLE 7.3-3
Existing and Future Condition Problem Locations
Grants Pass: Allen Fruitdale Creek Basins

Problem Location	Problem Description
	draining via 6th Street. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Potential opportunity to jointly treat runoff from 6th and 7th Street in a single water quality facility.
F-2	• **Cause:** No water quality treatment is currently provided for the areas draining via 7th Street. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Potential opportunity to jointly treat runoff from 6th Street and 7th Street in a single water quality facility
F-3	• **Cause:** Under capacity storm drain system between Reddy Street to the west and Playford Lane to the east. • **Impacts:** Manhole surcharging and flooding is predicted throughout the storm drain system and contributing upstream pipes segments. • **Opportunities:** A single project could potentially address the water quality problems identified in problem areas F-1 and F-2 along with the aforementioned flooding problems.
F-4	• **Cause:** Under capacity storm drain system along Harbeck Road between the ditch just north of Southridge Way and Skyline Drive to the South. Under capacity storm drain pipe along Southridge Way. • **Impacts:** Manhole surcharging and flooding is predicted throughout the storm drain system and contributing upstream pipes segments.
F-5	• **Cause:** No water quality treatment is currently provided for the areas tributary to this system. • **Impacts:** Untreated runoff is directly entering the Rogue River. • **Opportunities:** Water quality can be address for the two tributary drain systems via a single project.
F-6	• **Cause:** Under capacity culvert crossing • **Impacts:** Subgrade inundation and roadway overtopping • **Opportunities:** Replacing this culvert will provide a joint opportunity to eliminate a flooding problem and improve fish passage within the basin.
F-7	• **Cause:** High runoff rates and large spills from the canals results in excessive flows in lower Fruitdale Creek. • **Impacts:** Localized creek flooding is experienced along Fruitdale Creek at Fruitdale Drive. • **Opportunities:** A regional detention facility in the upper portion of the

TABLE 7.3-3
Existing and Future Condition Problem Locations
Grants Pass: Allen Fruitdale Creek Basins

Problem Location	Problem Description
	basin would provide peak flow management for the lower reaches.
C-1	• **Cause:** Runoff entering the South Highline Canal exceeds the canals conveyance capacity at number of locations between Fruitdale Creek and Allen Creek. • **Impacts:** Localized flooding caused by canal overtopping is expected on the north side of the canal. Flooding is also expected in the storm drain systems on the south side of the canal due to the capacity limitations of the canal.
C-2	• **Cause:** Runoff entering the South Main Canal exceeds the canals conveyance capacity at number of locations between Fruitdale Creek and Allen Creek. • **Impacts:** Localized flooding caused by canal overtopping is expected on the north side of the canal. Flooding is also expected in the storm drain systems on the south side of the canal due to the capacity limitations of the canal.

7.3.10 Skunk Creek and Jones Creek Basins - Existing Deficiencies

7.3.10.1 Storm Drain Surcharging

Storm drain problems are shown in Appendix G-10. System modeling identified 106 modeled storm drain manholes that exceed the surcharging criteria. Moreover, 55 of the 291 drainage nodes also produce adjacent surface/street flooding. In terms of general problem locations, these storm drain deficiencies are primarily focused in thirteen areas;

1. Dewey Street southwest to Outlook Street and 7th Street.
2. Savage Street from the Tokay Canal to west of 10th Street
3. The Croxton Avenue channel southwest to Wharton Street and 9th Street.
4. 'A' Street from Elida Drive to Beacon Drive.
5. 'D' Street and Candy Lane south to the Rogue River.
6. 'D' Street from Silverwood Place to west of Anderson Street and south to 'F' Street.
7. 'A' Street and 12th Street south-southwest to the Mill Street Southern Oregon and Pacific Railroad crossing.
8. Agnes Avenue from Grants Pass Parkway south to 'F' Street.
9. N.E. 'F' Street from Agnes Avenue west to Grants Pass Parkway and southwest along Grants Pass Parkway to the Mill Street Drainageway.
10. 'M' Street from Fern Street west to the Mill Street Drainageway.
11. The Skunk Creek crossing at Evelyn Avenue.
12. 'N' Street from 'M' Street west and south to the Leigh canal
13. 'D' Street from Foothill Boulevard west to 12th Street.

The remaining system deficiencies are not grouped in any way and are simply a result of localized hydraulic restrictions.

7.3.10.2 Channel Flooding

Channel flooding in the Skunk Creek basin is predicted as several locations including Skunk Creek at the Southern Oregon and Pacific Railroad crossing, a significant portion of the Mill Street channel, the open channel segment immediately east of Croxton Street and the channel/ditch north of the Southern Oregon and Pacific Railroad near Mill Street. Significant flooding is not predicted along the Tokay Canal and the Demarey and Leigh laterals due to the significant spill points that relieve excess flows. However, if the channels are not maintained and significant siltation or debris collection occurs, localized flooding would be expected. No significant flooding is predicted along Jones Creek within the Urban Growth Boundary.

7.3.10.3 Culvert Crossings

System modeling identified three culverts where channel flows overtopped the roadway or inundated the sub grade to within one (1) foot of the crown. These locations are; 1) Skunk Creek at Evelyn Avenue, 2) Skunk Creek at the Southern Oregon and Pacific Railroad crossing, and 3) the section of the Mill Street Drainageway from 'D' street south to the Rogue River. The third area, the Mill Street Drainageway, is not an isolated location but a series of culverts and channels that are hydraulically overloaded. These locations are shown on Appendix G-10.

7.3.10.4 Water Quality Areas of Concern

Several pollutants including copper, phosphorus and lead produce elevated concentrations throughout the basin. Others like zinc are generally at or below the project water quality criteria limits. Due to the relatively consistent level of development throughout the Skunk Creek basin, key water quality areas of concern are located throughout the basin. Conversely, there are limited water quality areas of concern within Jones Creek due to the lack of significant development. Existing water quality areas of concern are shown in Appendix G-11.

7.3.11 Skunk Creek and Jones Creek Basins - Future Deficiencies

7.3.11.1 Storm Drain Surcharging

Future storm drain problem areas are shown in Appendix G-12. System modeling identified 104 modeled storm drain manholes that exceed the surcharging criteria. Moreover, 57 of the 293 drainage nodes also produce adjacent surface flooding. In terms of problem identification, the same problem areas that are present for the low impact development scenario are also deficient for the full build-out scenario.

7.3.11.2 Channel Flooding

As with the two previous scenarios, the same network segments are expected to have flooding problems, as shown on Appendix G-12.

7.3.11.3 Culvert Crossings

The same locations on Skunk Creek receive flow rates that are above their hydraulic full-flow capacity. Similar to the future conditions scenario, the depth of surcharge overtops the road surface. As a result, these locations are considered hydraulic problems.

7.3.11.4 Water Quality Areas of Concern

Generally, the same water quality areas of concern were predicted for the low impact development scenario as for the existing and future conditions scenario. Refer to Appendix G-11 for the water quality areas of concern.

7.3.12 Skunk Creek and Jones Creek Basins - Problem Locations

Existing and future condition problem locations are shown on Figure 7.3-4. The cause of the problem, the impacts resulting from the problem, and opportunities for addressing each problem area, are summarized below in Table 7.3-4.

TABLE 7.3-4
Existing and Future Condition Problem Locations
Grants Pass: Skunk and Jones Creek Basins

Problem Location	Problem Description
S-1	• **Cause:** The combined pipe and natural channel system immediately downstream of the Tokay spill point are over capacity. • **Impacts:** Localized flooding along channels segments and surcharging of the piped system produces localized residential and commercial flooding. • **Opportunities:** Improve the hydraulic conditions of the channel will provide flood relief for this area.
S-2	• **Cause:** Spillage from the Tokay Canal is exceeding the hydraulic capacity of downstream storm system. • **Impacts:** Manhole surcharging and flooding along Savage Street. • **Opportunities:** Modifying the spill point of Tokay Canal could limit flow to this system. Improve the hydraulic conditions of the downstream pipe will alleviate adjacent flooding.
S-3	• **Cause:** The existing storm drain pipe downstream of the Croxton Avenue channel is undersized. Additionally, the open channel itself is poorly maintained and has limited conveyance and storage capacity. • **Impacts:** The existing storm drain system is backing up flow in the open channel reach east of Croxton Avenue causing minor flooding. • **Opportunities:** Connect to existing stub-out line and maintain natural channel. Add Water Quality MH to downstream end of subbasin.
S-4	• **Cause:** The limited capacity of the Mill Street drainageway significantly reduces the capacity of the ‘D’ Street storm drain by creating a backwater condition that dramatically reduces the pipe ability to convey design flows. • **Impacts:** Localized flooding on ‘D’ Street. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding along ‘D’ Street. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-5	• **Cause:** Excessive runoff from much of the Upper Skunk Creek basin passes through the Mill Street drainageway. Additionally, the relatively flat slope of the channel south of the Southern Oregon and Pacific Railroad further limits channel capacity. Other system elements that exasperate flooding include heavy vegetation, undersized culverts,

TABLE 7.3-4
Existing and Future Condition Problem Locations
Grants Pass: Skunk and Jones Creek Basins

Problem Location	Problem Description
	limited channel conveyance area, siltation and debris accumulation. • **Impacts:** Hydraulic deficiencies along this reach cause widespread backups and flooding throughout the connecting storm drain systems. • **Opportunities:** Increasing the hydraulic capacity through various improvements will most strongly reduce channel and storm drain flooding. Other opportunities include increasing channel maintenance to better keep the flow path unobstructed.
S-6	• **Cause:** The surcharging and flooding associated with this relatively flat-sloped pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts:** Localized surcharging and flooding. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-7	• **Cause:** The surcharging and flooding associated with this pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts:** Localized surcharging and flooding. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-8	• **Cause:** The surcharging and flooding associated with this relatively flat-sloped pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts:** Localized surcharging and flooding. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-9	• **Cause:** The high levels of impervious surfaces in the contributing catchments results in increased peak flows and runoff volumes. Additionally, hydraulic deficiencies downstream in the Mill Street drainageway exasperate capacity problems. • **Impacts:** Widespread surcharging and flooding id predicted in areas contributing to this storm drain system. • **Opportunities:** Diverting flows south to the best extent possible to other existing outfalls with available capacity. Projects related to the Mill Street Drainageway will also address these problems.

TABLE 7.3-4
Existing and Future Condition Problem Locations
Grants Pass: Skunk and Jones Creek Basins

Problem Location	Problem Description
S-10	• **Cause:** The surcharging and flooding associated with this pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts:** Localized surcharging and flooding. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-11	• **Cause:** Both the Evelyn Street culvert and the preceding channel are slightly over-capacity for the future system flow. • **Impacts:** The channel backs up at culvert entrance and causes localized road overtopping. • **Opportunities:** Replace the existing culvert, improve the entrance conditions, and improve upon channel maintenance practices. A water quality treatment device at this location will also be beneficial.
S-12	• **Cause:** The surcharging and flooding associated with this relatively flat-sloped pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts:** Localized surcharging and flooding. • **Opportunities:** Limited practical opportunities exist to correct the localized flooding. Rather, projects related to the Mill Street Drainageway will best address these problems.
S-13	• **Cause:** The existing pipe system is undersized during peak flows. Additionally, the surcharging and flooding associated with this pipe system are dramatically increased by the hydraulic deficiencies downstream in the Mill Street Drainageway. • **Impacts**: Local and downstream hydraulic deficiencies are causing flooding along 'D' Street. • **Opportunities:** Limited local opportunities exist to correct this localized flooding. Increasing the diameter of the pipes along 'D' Street only partially reduce the flooding potential here. Again, projects related to the Mill Street Drainageway will best address these problems.
S-14	• **Cause:** The Tokay Canal spills a significant amount of runoff into the existing storm drain system and is ultimately conveyed to the under capacity Mill Street Drainageway through problem locations S-4, S-7, S-8 and S-9. • **Impacts:** Localized and downstream flooding can result from these spills in addition to the flooding along the Mill Street drainageway. • **Opportunities:** This site offers the opportunity for detention at the

TABLE 7.3-4
Existing and Future Condition Problem Locations
Grants Pass: Skunk and Jones Creek Basins

Problem Location	Problem Description
	Tokay Canal to reduce the peak flows and runoff volume being released to the canal, the storm drain and the Mill Street drainageway.
S-15	• **Cause:** The limited hydraulic capacity of Skunk Creek culvert at the Southern Oregon and Pacific Railroad. • **Impacts:** The flow backs up at culvert entrance and causes significant surcharging and ponding. • **Opportunities:** Increase culvert size.
R-1	• **Cause:** Urbanization in the contributing areas have little or no water quality treatment prior to being discharged to the Rogue River. • **Impacts:** Discharge of runoff that exceeds project water quality limits. • **Opportunities:** Due to site constraints, the installation of a proprietary water quality manhole is recommended.
R-2	• **Cause:** Urbanization in the contributing areas have little or no water quality treatment prior to being discharged to the Rogue River. • **Impacts:** Discharge of runoff that exceeds project water quality limits. • **Opportunities:** Due to site constraints, the installation of a proprietary water quality manhole is recommended.
R-3	• **Cause:** Urbanization in the contributing areas have little or no water quality treatment prior to being discharged to the Rogue River. • **Impacts:** Discharge of runoff that exceeds project water quality limits. • **Opportunities:** Due to site constraints, the installation of a proprietary water quality manhole is recommended.

7.3.13 Summary of Problem Areas

To develop a capitol improvement plan that appropriately allocates cost for existing problems and those related to development, it is necessary to identify the areas that contribute to both existing and future system deficiencies. The following tables (7.3-5 through 7.3-8) summarize each problem area, whether or not it is an existing deficiency, a result of urbanization, or a combination of the two and the contributing impervious percentages.

TABLE 7.3-5
Problem Area Summary
Grants Pass: Sand Creek Basin

Problem ID	Contributing Area (acres)[1]	Existing Imperviousness (%)[1]	Future Imperviousness (%)[1]	Source	Existing Deficiency	Future Deficiency
SA-1	10.2	53%	60%	WQ	YES	YES
SA-2	51.8	60%	74%	WQ, SDS	YES	YES
SA-2A	36.7	57%	71%	SDS	NO	YES
SA-3[2]	108.8	57%	63%	CF, SDS	YES	YES
SA-4	82.2	51%	65%	WQ, SDS	YES	YES
SA-4A	130.9	47%	62%	WQ	YES	YES
SA-5	28.5	52%	52%	WQ, SDS	YES	YES
SA-5A	76.5	59%	64%	WQ	YES	YES
SA-6	68.5	34%	58%	SDS	YES	YES
SA-7	180.6	46%	60%	CC, CF	YES	YES
SA-8	78.3	43%	62%	SDS, WQ	NO	YES
SA-9[2]	73.2	54%	66%	CC	NO	YES
SA-10	70.9	39%	53%	SDS, WQ	YES	YES
SA-11	286.4	45%	60%	CC	NO	YES
SA-12[2]	70.8	55%	66%	CC, CF	YES	YES

Problem Source: WQ = water quality, SDS = storm drain surcharging, CC = culvert crossing, CF = channel flooding
Note 1. Contributing area and existing and future imperviousness are summarized within the UGB.
Note 2. Primary contributing area outside of UGB.

TABLE 7.3-6
Problem Area Summary
Grants Pass: Gilbert Creek Basin

Problem ID	Contributing Area (acres) [1]	Existing Imperviousness (%) [1]	Future Imperviousness (%) [1]	Source	Existing Deficiency	Future Deficiency
G-1	198.2	49%	55%	SDS, WQ	YES	YES
G-1A	35.2	49%	51%	WQ	YES	YES
G-2	185.6	53%	60%	WQ	YES	YES
G-3	138.0	57%	63%	WQ	YES	YES
G-4	53.6	48%	62%	CF, CC	YES	YES
G-5	118.6	58%	64%	SDS	YES	YES
G-6	30.1	63%	68%	SDS	YES	YES
G-7	32.3	69%	72%	SDS	YES	YES
G-8	36.6	71%	77%	SDS	YES	YES
G-9	58.5	64%	68%	SDS	YES	YES
G-10	147.5	73%	77%	SDS, WQ	YES	YES
G-11	278.7	22%	40%	CF, SDS, WQ	YES	YES
G-12	68.5	55%	65%	SDS	YES	YES
G-13	194.8	61%	66%	WQ	YES	YES
G-14	76.2	44%	51%	SDS, CF	YES	YES
G-14A	27.4	31%	42%	SDS	YES	YES
G-14B	253.6	20%	39%	CF, WQ, SDS	NO	YES
G-15	292.4	46%	53%	WQ	YES	YES

TABLE 7.3-6
Problem Area Summary
Grants Pass: Gilbert Creek Basin

Problem ID	Contributing Area (acres)[1]	Existing Imperviousness (%)[1]	Future Imperviousness (%)[1]	Source	Existing Deficiency	Future Deficiency
G-16[2]	91.9	72%	72%	CF	YES	YES
G-17	78.1	40%	47%	SDS	YES	YES
G-17A	35.3	43%	49%	SDS	YES	YES
G-18[2]		N/A		CF, CC, WQ, SDS	YES	YES
G-19[2]	54.5	70%	70%	SDS	YES	YES

Problem Source: WQ = water quality, SDS = storm drain surcharging, CC = culvert crossing, CF = channel flooding
Note 1. Contributing area and existing and future imperviousness are summarized within the UGB.
Note 2. Primary contributing area outside of UGB.

TABLE 7.3-7
Problem Area Summary
Grants Pass: Allen and Fruitdale Creek Basins

Problem ID	Contributing Area (acres)[1]	Existing Imperviousness (%)[1]	Future Imperviousness (%)[1]	Source	Existing Deficiency	Future Deficiency
A-1[2]	890.0	42%	50%	CC	NO	YES
A-2	35.4	62%	72%	WQ	NO	YES
A-3	69.6	24%	41%	CF, WQ	YES	YES
A-4	124.1	57%	66%	WQ	YES	YES
A-5	47.7	60%	67%	WQ	YES	YES
A-7[2]		N/A		CF	YES	YES
F-1	165.9	67%	72%	WQ	YES	YES
F-2		Same as F-1		WQ	YES	YES
F-3	64.0	64%	69%	SDS	YES	YES
F-4	46.4	42%	57%	SDS	YES	YES
F-5	176.6	57%	63%	SDS, WQ	YES	YES
F-6[2]	203.5	35%	46%	SDS, WQ	YES	YES
F-7[2]	64.0	64%	69%	CF	YES	YES
C-1[2]		N/A		CF	YES	YES
C-2[2]		N/A		CF	YES	YES

Problem Source: WQ = water quality, SDS = storm drain surcharging, CC = culvert crossing, CF = channel flooding
Note 1. Contributing area and existing and future imperviousness are summarized within the UGB.
Note 2. Primary contributing area outside of UGB.

TABLE 7.3-8
Problem Area Summary
Grants Pass: Skunk and Jones Creek Basins

Problem ID	Contributing Area (acres)[1]	Existing Imperviousness (%)[1]	Future Imperviousness (%)[1]	Source	Existing Deficiency	Future Deficiency
S-1	136.2	47%	53%	CF, SDS	YES	YES
S-2	78.0	50%	56%	SDS	YES	YES
S-3	212.2	58%	61%	CF, SDS, WQ	YES	YES
S-4	61.6	61%	63%	SDS	YES	YES
S-5	930.7	64%	69%	SDS, CF, CC	YES	YES
S-6	43.5	72%	73%	SDS	YES	YES
S-7	285.3	62%	65%	SDS	YES	YES
S-8	52.7	88%	88%	SDS	YES	YES
S-9	305.8	67%	75%	SDS	YES	YES
S-10	61.6	78%	78%	SDS, WQ	YES	YES
S-11	237.8	55%	62%	SDS, CF, WQ	YES	YES
S-12	206.8	68%	75%	SDS, WQ	YES	YES
S-13	67.9	61%	62%	SDS	YES	YES
S-14[2]		N/A		CF, SDS	YES	YES
S-15	442.9	56%	65%	CC	YES	YES
R-1	96.7	53%	67%	WQ	YES	YES
R-2	16.5	65%	65%	WQ	YES	YES
R-3	287.2	66%	71%	WQ	YES	YES

Problem Source: WQ = water quality, SDS = storm drain surcharging, CC = culvert crossing, CF = channel flooding
Note 1. Contributing area and existing and future imperviousness are summarized within the UGB. Note 2. Primary contributing area outside of UGB.

7.3.14 Observed Flooding

The storm event of late January, 2006 produced significant localized flooding problems throughout the city. Although, statistically, this event appears to be significantly less than the 25-yr design storm, it still resulted in number of flooded areas within the city. Based on city maintenance records, the following areas were identified as having capacity problems or flooded. Many of these areas are addressed in the recommended plan discussed in Sections 8 and 9, however a number are smaller problems areas were not analyzed due to the limited scope of this stormwater facility master plan. Nonetheless, each problem area is highlighted below in Table 7.3-9 and illustrated graphically in Appendix H.

TABLE 7.3-9
Summary of Observed Flooding Areas within the City
Grants Pass: SWFMP

Problem Location	Resolution
• Canal overflows along Leonard Road west of the city	Not addressed; Outside UGB
• Insufficient capacity along Leonard Road at Willow Lane	Addressed; SA-8
• Excessive ground saturation along Willow Lane at Estates Lane	Not addressed; Minor drainage problem
• Insufficient capacity along Redwood Avenue between Kokanee Lane and Kellenbeck Avenue	Addressed; SA-4
• Insufficient capacity of wetlands, ponds and canals immediately east or Hubbard Lane	Addressed; SA-6
• Localized flooding along Demaray Drive north of Hubbard Lane	Not addressed; Outside UGB
• Insufficient capacity of the South Main Canal east of Medart Lane	Addressed; SA-3
• Insufficient capacity of the South Highline Canal at Sand Creek	Not addressed; Outside UGB
• Localized flooding of Allen Creek north of Ramsey Avenue	Addressed; A-7
• Yard flooding due to insufficient drain capacity along West Harbeck Avenue at Colorado Lane	Not addressed; Minor drainage problem
• Flooding along Princeton Place (caused by runoff from Byron Court)	Not addressed; Minor drainage problem
• Insufficient capacity along Williams Highway at New Hope Road	Not addressed; Minor drainage problem
• Insufficient capacity along Jacksonville Highway between Allenwood Drive and Corbin Drive	Not addressed; Minor drainage problem
• Flooding along Lark Ellen Way	Addressed; A-6
• Localized flooding along Williams Highway north of Meridian Way (lack of storm drain system)	Addressed; A-6

• Localized flooding along Southridge Road and Independence Drive	Addressed; F-4
• Insufficient capacity east of Poplar Drive in the vicinity of the South Main Canal	Not addressed; Minor drainage problem
• Insufficient storm drain capacity along Blue Moon Lane	Not addressed; Minor drainage problem
• Insufficient capacity of Fruitdale Avenue culvert at Fruitdale Creek	Addressed; F-6 & F-7
• Significant flooding along the Mill Street Drainageway at “J” Street	Addressed; S-5
• Overflow of the Tokay Canal at “A” Street	Partially addressed; S-14
• Manhole surcharging along “A” Street at Flint Street	Addressed; S-3 & S-5
• Manhole surcharging along Konklin Avenue between Savage Street and Midland Avenue	Not addressed; Minor drainage problem
• Channel bank failure in the adjacent trailer park	Addressed; G-16
• Bank failure along Crown Street at Sunburst Way	Not addressed with stormwater CIP project
• Overflow of the Tokay Canal east of the Blue Gulch Area	Not addressed; Outside UGB
• Insufficient storm drain capacity in new development at Blenda Court	Not addressed; Minor drainage problem
• Insufficient capacity at end of storm drain system along Larch Road at Judy Lane	Not addressed; Minor drainage problem

In addition to the capacity and flooding problems identified during the January 2006 storm event, several other locations within the city are known to be common flooding problems. These areas were identified by city maintenance staff during the data collection phase of this project and are summarized below in Table 7.3-10.

TABLE 7.3-10
Summary of Observed Flooding Areas within the City
Grants Pass: SWFMP

Problem Location	Resolution
• Highland Avenue at Starlite Place	Addressed; G-14
• The vacant lot immediately east of Gilbert Creek and South of Interstate-5	Addressed; G-18
• The Overlook Avenue area	Partially addressed; S-14
• The Croxton Avenue open channel reach	Addressed; S-3
• The Tokay Canal diversion structure at Jones Creek	Not addressed; Outside UGB
• The storm drain inlet along “B” Street at Grant Street	Addressed; G-11 & G-14B
• The existing culvert at Elmer Nelson Road	SA-12
• Lincoln Road south of “G” Street	G-4
• The northwest corner of Larch Road and Judy Lane	G-1

7.3.15 GPID Irrigation Canals

Based on the XP-SWMM model results, several locations along the GPID canal system were determined to be under capacity during the 25-year storm event. Additionally, a number of the smaller irrigation laterals are also known to flood during intense rain events. Although this flooding is primarily a result of the canal system intercepting too much upland runoff, the problem can be locally compounded by the presence of development whose runoff is directed into the canals.

In terms of specific problem locations within the UGB, the under capacity canals are primarily focused in three areas:

1) the South Main Canal between the southern extension of Kellenbeck Avenue and Hubbard Lane in the Sand Creek Basin,

2) various locations along the South Main Canal and the South Highline Canal to the east of Allen Creek, and

3) the Tokay Canal at “A” Street in the Skunk Creek Basin

The 1984 Stormwater Master Plan indicates that all of the diversion structures (locations where the canals spill into a creek), with the exception of the South Highline Canal at Sand Creek and the Tokay Canal at Jones Creek, have adequate capacity to spill flows.

7.3.16 Fish Passage Barriers

According to the Oregon Department of Fish and Wildlife (ODFW), each of the six basins within the city potentially has fish bearing habitat for Coho Salmon and Summer Steelhead. Additionally, ODFW has identified 18 fish passage barriers (culverts) within the Grants Pass UGB (Table 7.3-3). Although this list denotes the known fish passage barriers, it is not likely all inclusive. If at any time the city is planning on construction activities in the vicinity of the creek system, a fish passage evaluation may be triggered. If it is determined that the culvert is not passable, the city may be required to replace the culvert or perform in kind mitigation even if downstream fish passage barriers currently exist.

TABLE 7.3-11
Existing Fish Passage Barriers
Grants Pass: SWFMP

Stream Name	Culvert Location
Allen Creek	New Hope Road
Allen Creek	West Harbeck Road
Allen Creek	Unknown culvert near Allenwood Drive
Allen Creek	Redwood Highway
Fruitdale Creek	Cloverlawn Drive
Fruitdale Creek	Unknown culvert near Sunny Circle
Fruitdale Creek	Rogue River Highway
Fruitdale Creek*	Fruitdale Avenue
Fruitdale Creek	Unknown Near Swarthout Drive
Gilbert Creek	Midland Avenue
Gilbert Creek	Manzanita Avenue
Gilbert Creek	Central Avenue
Gilbert Creek	Rogue River Avenue
Jones Creek	NE "N" Street
Jones Creek	Foothills Boulevard
Jones Creek	Interstate-5
Jones Creek	Central Oregon & Pacific Railroad
Sand Creek	Hubbard Lane
Sand Creek	Redwood Highway

* indicates the culvert is also a hydraulic deficiency.

SECTION 8

System Improvement Recommendations

The objective of this chapter is to present the alternatives considered to resolve the system deficiencies identified in section 7 and to summarize the recommended solutions. In addition, this chapter summarizes the methods and factors considered in developing and screening the various alternatives.

8.1 Alternative Analysis

Alternatives for the system deficiencies identified in Section 7 and part of the primary conveyance system within the UGB were developed and evaluated using the project GIS and the XP-SWMM model. Each alternative can generally be described as either conveyance-oriented, water quality oriented, or as a dual-purpose facility. Conveyance alternatives include new or upsized storm drain pipes, enlarged culverts, improved channels or canals, flow diversions and detention ponds. Water quality improvements included ponds, channel enhancements and structural pollution reduction facilities. Structural pollution reduction facilities are considered water quality manholes and vaults using filtration and/or hydrodynamic separation as the pollutant removal mechanism. They can be proprietary or non-proprietary in design.

A number of alternatives were developed and evaluated for each problem area to arrive at a recommended or preferred alternative. Several alternatives resulted in a viable and constructible solution; however, the goal of improving system conveyance and water quality in a single facility typically became the deciding factor during the alternative selection process. The following section describes the alternative development and evaluation process and summarizes the recommended improvements.

8.1.1 Alternative Development

Multiple factors were used in developing each alternative. Although each problem area had unique constraints and required a different set of improvements, a number of common themes were followed:

- The existing drainage system is compartmentalized; that is, not all areas drain to a common outfall or receiving water body. Consequently, in developing alternatives, an attempt was made to provide water quality treatment facilities for the larger drainage sub-regions to mitigate for the increased pollutant loads generated from existing and future development within the basin.
- To minimize capital expenditures, the existing infrastructure was used to the maximum extent possible.

- Multi-use facilities, such as detention/water quality ponds, were used where practical.
- Land acquisition, in terms of size and development pressures, was considered when locating system improvements.
- Wetland mitigation and environmental permitting requirements were considered when locating system improvements alternatives.
- Where possible, retrofits were considered to minimize the number of capital projects.

8.1.2 Alternative Evaluation

In general, the identification of the recommended, or preferred, alternative was based on the need to provide water quality treatment for each primary drainage sub-region with high pollutant loads while also conveying the future peak flow and volume throughout the system. Moreover, environmental permitting and alignment opportunities were major considerations in identifying the recommended alternative. For those improvements where there was not a clear preferred alternative, rough capital costs estimates were used to identify the recommended solution. The general process used to evaluate the alternatives is detailed as follows:

- Is a pipe system the only viable alternative?
- Can the new or upsized pipes be eliminated by using detention or flow diversion facilities?
- Does the alternative provide water quality treatment? At a minimum, do the areas that generate the highest pollutant loads (i.e. commercial and industrial parcels) have water quality treatment?
- Is the water quality treatment structural or non-structural?
- Is environmental permitting/wetland mitigation likely?
- To what level is land acquisition required?
- Will construction-related implementation issues be significant (e.g., roadway closures, large excavations, utility relocations)?
- Can the system be rearranged/modified to eliminate the need to replace existing infrastructure?
- Will the alternative be cost effective?
- Will the alternative be maintainable long-term?
- Are the facilities accessible for maintenance?

8.2 Alternatives and Recommendations

A summary of the alternatives is included in the following pages. Each summary notes the problem identification code that can be referenced to section 7. Each summary also includes the following:

- ***Problem Summary***. Summarizes the system problems as developed using the problem identification criteria.

- ***Alternative Summary***. Provides a narrative of the components for each alternative developed. This includes a description of alignment corridors, pipe diameters and lengths, length of channel improvements and swales, and other improvement-related information needed to implement the project.
- ***Benefits***. Identifies the problems resolved or those not resolved with each alternative. Also identifies the benefits relative to another alternative described for the same problem location.
- ***Technical Data***. Summarizes the hydraulic data needed to initiate the preliminary and final design process. This includes design flows, storage volumes and maximum water surface elevation.
- ***Implementation Issues***. Identifies issues that would affect construction, permitting, and/or land acquisition for each alternative. Also identifies special construction techniques necessary to implement the alternatives.
- ***Cost***. Identifies the total project cost including construction, land acquisition, engineering and administration for the recommended alternative. Basis of costs, assumptions, and the anticipated level of accuracy is described in the System Improvement Recommendations section (9.1). Detailed cost summaries for each of the recommended alternatives are included in Appendix C.

8.2.1 Sand Creek Basin: Alternative Summary Tables

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-1	Discussion
Problem Location:	The Sunset Knoll Subdivision.
Problem Summary:	Ineffective water quality treatment facility
Alternative 1:	This alternative consists of retrofitting the existing water quality pond with a new manhole and associated piping to maximize the water quality treatment for the subdivision.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would enter the South Main Canal and ultimately Sand Creek. • Utilizes existing stormwater infrastructure and land
Technical Data:	Peak water quality flow is 0.8 cfs and required treatment volume is 1.4 ac-ft.
Implementation Issues:	Wetland determination/delineation and mitigation may be required. No other significant implementation issues;
Capital Cost:	$ 37,753
***Alternative 2:**	This alternative consists of abandoning the existing water quality pond and constructing a new large regional detention/water quality pond immediately to the east of the Sunset Knoll Subdivision and South of the South Main Canal. A new diversion pipe and channel would connect the existing storm drain to the recommended facility and a diversion structure on the South Main Canal would enhance for flood protection downstream along the Canal by detaining peak flows during the winter.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would enter the South Main Canal and ultimately Sand Creek. • Utilizes land owned by the city • Provides flood protection along the South Main Canal in the Redwood Area.
Technical Data:	Peak water quality flow is 0.8 cfs; required water quality treatment volume is 1.4 ac-ft; required detention volume is 10 ac-ft.
Implementation Issues:	Wetland determination/delineation and mitigation may be required. Will require coordination with GPID.
Capital Cost:	$ 332,146

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-2	Discussion
Problem Location:	Redwood Circle and vacant lands west of retirement complex
Problem Summary:	Insufficient drainage capacity resulting in localized street flooding and manhole surcharging.
Alternative 1:	Upsize the existing 12" storm drain pipe to 24" between Redwood Ave and Redwood Circle cul-de-sac
Benefits:	Eliminates flooding along Redwood Circle
Technical Data:	25-yr design flows range from 10 cfs to 25 cfs.
Implementation Issues:	Will require traffic control and possible short-term closing of Redwood Circle. Probable utility conflicts and difficult connection to the existing pond.
Capital Cost:	None developed
***Alternative 2:**	Construct a detention/water quality facility immediately to the southeast of the Redwood Circle cul-de-sac. Construction of a new 24" storm drain along Redwood Ave which will connect to the new pond via a combined pipe/surface conveyance system.
Benefits:	• Eliminates flooding along Redwood Circle • Provides water quality treatment and reduces pollutant loads that are generated from the commercial and industrial parcels south of Redwood Ave. • Provides the drainage system along Redwood Ave to allow for new curb and gutter construction.
Technical Data:	25-yr design flows range from 10 cfs to 25 cfs. Peak water quality flow is 1.4 cfs and required treatment volume is 2.8 ac-ft.
Implementation Issues:	Will require storm pipe along Redwood Ave to be installed relatively shallow, due to grade limitations. Probable utility relocations. Will require lane closures along Redwood Ave. May require wetland permitting including a determination/delineation and mitigation. May need to fit within future development plans for the adjacent retirement facility. Will require approximately 1.0 acres of land acquisition.
Capital Cost:	$ 1,533,772

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-2A	Discussion
Problem Location:	Redwood Ave east of Wineteer Ln.
Problem Summary:	Insufficient drainage capacity in neighboring ditch resulting in localized flooding (reoccurring problem area noted by county).
Alternative 1:	Construct a new 24” storm drain along Redwood Ave from Winteer Ln west approximately 450 feet.
Benefits:	Eliminates neighboring ditch flooding along Redwood Ave.
Technical Data:	25-yr design flow: 18 cfs.
Implementation Issues:	Will require traffic control and possible short-term closing of Redwood Ave. Probable utility conflicts.
Capital Cost:	$ 164,600

TABLE 8.2-6
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-3	Discussion
Problem Location:	South Main Canal between Willow Ln and Medart Ln
Problem Summary:	Under capacity storm drain system beneath the Redwood Heights Subdivision
Alternative 1:	This alternative consists of the construction of a diversion structure in the canal upstream of Medart Lane and a bypass channel along Redwood Hwy discharging back in to the canal at Willow Lane.
Benefits:	• Eliminates surface flooding in the immediate storm drain system and upstream along the South Main Canal. • Does not require upsizing existing storm drain system.
Technical Data:	Peak bypass flow is 100 cfs, peak flow remaining in existing drain system is 47 cfs.
Implementation Issues:	Possible construction of new intersection at Willow Ln and Redwood Highway makes an open channel system not a viable alternative. Construction activities will need to be coordinated with ODOT.
Capital Cost:	None developed
Alternative 2:	This alternative consists of the construction of a diversion structure and bypass pipe system (dual 48") along the alignment described in Alternative 1.
Benefits:	• Eliminates surface flooding in the immediate storm drain system and upstream along the South Main Canal. • Does not require upsizing existing storm drain system.
Technical Data:	Peak bypass flow is 100 cfs, peak flow remaining in existing drain system is 47 cfs.
Implementation Issues:	A full piped system would significantly increase project costs. Construction activities will need to be coordinated with ODOT.
Capital Cost:	None developed
***Alternative 3:**	This alternative consists of the construction of a diversion structure and a combined bypass channel and pipe system along the alignment described in Alternative 1. The open channel portion would extend along Redwood Highway to the Willow Ln intersection, where it would be piped back to the South Main Canal.
Benefits:	• Eliminates surface flooding in the immediate storm drain system and upstream along the South Main Canal. • Does not require upsizing existing storm drain system. • Allows for future development of Willow Ln intersection
Technical Data:	Peak bypass flow is 100 cfs, peak flow remaining in existing drain system is 47 cfs.
Implementation Issues:	Construction activities will need to be coordinated with ODOT.
Capital Cost:	$ 335,448

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-4	Discussion
Problem Location:	Sun Glo Dr. south of Redwood Ave, Redwood Ave between Willow Ln and Dowell Rd and Dowell Rd between Leonard Rd and Redwood Ave.
Problem Summary:	Street flooding and excessive storm drain surcharging. Untreated industrial and commercial runoff draining directly to the Rogue River.
Alternative 1:	Upsize storm drain along Sun Glo Dr. and Redwood Ave.
Benefits:	• Eliminates street flooding and excessive surcharging • Utilizes existing right-of-way for storm drain system
Technical Data:	25-yr peak design flows range from 3.4 cfs to 29 cfs.
Implementation Issues:	Significant road closures or temporary traffic management required. Significant roadway repair required.
Capital Cost:	None developed
***Alternative 2:**	Construct a new storm drain along Redwood Ave between Willow Ln to the west and Sun Glo Dr. to the east. Disconnect the Sun Glo Dr. drainage from the Willow Ln system and connect to new storm drain.
Benefits:	• Eliminates street flooding and excessive surcharging • Reduces flow conveyed to Problem ID SA-5. • Redirects industrial and commercial runoff to structural pollution reduction facility and the South Downs Estates ponds. Additional runoff conveyed to surface facilities. • Continues the storm drain network along Redwood Ave so that roadway improvements and curb and gutter can be installed. • Utilizes existing right-of-way for storm drain system
Technical Data:	25-yr peak design flows range from 3.4 cfs (at the south end of Kellenbeck Ave) to 62 cfs (along Kellenbeck Ave north of Redwood Ave).
Implementation Issues:	Significant road closures or temporary traffic management required along Redwood Ave. Significant roadway repair required. Possible utility relocations.
Capital Cost:	$ 1,171,856

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-4A	Discussion
Problem Location:	North End of Kellenbeck Ave near Leonard Rd
Problem Summary:	Untreated commercial and industrial runoff draining to the South Downs Estates ponds.
Alternative 1:	Reconstruct the existing channel into a water quality swale
Benefits:	• Reduction in pollutant concentrations and loads (primarily TSS) entering the South Downs Estates ponds. • Located for maintenance accessibility
Technical Data:	Peak water quality flow is 15.8 cfs.
Implementation Issues:	• Lacking adequate swale length to accommodate water quality flows. • Re-suspension of pollutants
Capital Cost:	None developed
***Alternative 2:**	Install proprietary pollution reduction facility targeting sediment removal
Benefits:	• Provides significant reduction in pollutant concentrations and loads (primarily TSS) entering the South Downs Estates ponds reducing sediment loads and pond maintenance. • Fits within existing public right-of-way • Located for maintenance accessibility
Technical Data:	• Off-line facility. • Diversion structure and facility sized for peak water quality flow is 15.8 cfs.
Implementation Issues:	• Proprietary facility must be able to accommodate shallow installation.
Capital Cost:	$ 140,044

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-5	Discussion
Problem Location:	North extension of Dowell Rd
Problem Summary:	Insufficient drainage capacity resulting in localized street flooding.
Alternative 1:	Install parallel 36” drain pipe to relieve overcapacity drainage system
Benefits:	• Eliminates surface flooding • Utilizes existing stormwater infrastructure
Technical Data:	25-yr peak design flow: 42.6 cfs.
Implementation Issues:	Pipe to be installed parallel to existing storm drain. Shallow excavation and limited cover. Possible utility conflicts. Possible right-of-way and/or easements required.
Capital Cost:	$ 107,822

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-5A	Discussion
Problem Location:	Mesman Dr. cul-de-sac
Problem Summary:	Untreated stormwater runoff draining directly to the Rogue River.
Alternative 1:	Construct water quality swale along existing channel downstream of Mesman Drive.
Benefits:	• Provides significant reduction in pollutant concentrations and loads prior to entering the Rouge River. • Property acquisition required • Poor maintenance accessibility
Technical Data:	Peak water quality flow is 2.8 cfs.
Implementation Issues:	• Environmental permitting difficult as other options exist.
Capital Cost:	None developed
***Alternative 2:**	Install proprietary pollution reduction facility and new outlet pipe. (Outlet pipe replacement requires additional survey and analysis; problem noted by County)
Benefits:	• Provides significant reduction in pollutant concentrations and loads prior to entering the Rouge River. • Fits within existing public right-of-way • Located for maintenance accessibility
Technical Data:	• Peak water quality flow is 2.8 cfs. • Target pollutants include metals, nutrients and TSS.
Implementation Issues:	• Possible utility relocations. Relatively deep structural facility (approx. 10+ feet to pipe invert with additional depth to facility sump)
Capital Cost:	$ 226,494

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-6	Discussion
Problem Location:	The intersection of George Tweed Boulevard and Redwood Avenue as well as Eastwood Lane.
Problem Summary:	Insufficient drainage capacity resulting in localized street flooding and manhole surcharging.
Alternative 1:	Upsize the existing storm drain system along Redwood Avenue and George Tweed Boulevard.
Benefits:	• Eliminates street flooding and manhole surcharging
Technical Data:	25-yr peak design flows range from 3.3 cfs to 23 cfs.
Implementation Issues:	Significant road closures or temporary traffic control required along Redwood Ave. Possible utility conflicts
Capital Cost:	None developed
***Alternative 2:**	Construct a detention/water quality facility immediately to the south of the Redwood Avenue at Kokanee Lane. Utilize existing wetland immediately south of pond site for conveyance and supplemental detention and water quality treatment.
Benefits:	• Eliminates flooding along Redwood Ave, George Tweed and Eastwood Ln. • Eliminates the need to replace existing storm drain infrastructure • Provides water quality treatment and reduces pollutant loads that are generated from the residential developments occurring to the South of Redwood Ave.
Technical Data:	25-yr design flow entering pond is 10.6 cfs[1]. Peak water quality flow is 2.8 cfs and required treatment volume is 1.1 ac-ft.
Implementation Issues:	Will require brief periods of temporary traffic control and/or road closures along Redwood Ave. May require wetland permitting including a determination/delineation and mitigation. Will require approximately 0.5 acres of new land acquisition. See Note 1.
Capital Cost:	$ 397,665

Note 1: This design flow assumes a 2.5 ac-ft detention/water quality facility will be installed at the proposed residential development between Redwood Hwy and the South Main Canal (south and north) and Sand Creek and Willow Ln (west and east).

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-7	Discussion
Problem Location:	Leonard Rd and Dinkle Ln.
Problem Summary:	Undersized culvert and under-capacity drainage channel produces surface flooding along Leonard Rd.
Alternative 1:	Replace existing culvert and increase the downstream channel capacity through re-grading, realignment and vegetation removal/restoration.
Benefits:	• Eliminates surface flooding
Technical Data:	25-yr design flow is 102 cfs.
Implementation Issues:	May require wetland permitting including a determination/delineation and mitigation for realigned channel. May require new land acquisition or transfer.
Capital Cost:	$ 179,502

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-8	Discussion
Problem Location:	Willow Ln, Leonard Rd and Schroeder Ln
Problem Summary:	Partially completed piped storm drain system causes significant surcharging and flooding.
Alternative 1:	Install new storm drain pipe along Willow Ln from existing pipe termination to Leonard Rd. Install new storm drain pipe east along Leonard Rd from Schroeder Ln to existing drainage channel near Dinkle Ln.
Benefits:	• Eliminates flooding and reduces surcharging • All construction activities in public right-of-way and within Urban Growth Boundary
Technical Data:	25-yr design flow is 34 cfs.
Implementation Issues:	Pipe outfall will be 8+ feet below the channel invert and the storm drain system will need to be designed to accommodate surcharging and permanent water pool. Potential long-term maintenance issues including sediment removal. Possible utility relocations. Temporary traffic management of brief roadway closures will be required. Relatively deep excavations (approx 10+ feet). Large diameter pipe required along Leonard Rd due to slope limitations.
Capital Cost:	None developed.
***Alternative 2:**	Install new storm drain pipe along Willow Ln and Schroeder Ln from existing pipe termination to north end of Schroeder Ln. Install new storm drain pipe along Leonard Rd between Angler Ln and Willow Ln. Install proprietary pollution reduction facility.
Benefits:	• Eliminates flooding and surcharging along Willow Ln and Angler Ln. • All construction activities in public right-of-way and within Urban Growth Boundary • Provides water quality treatment for tributary residential developments and transportation corridors. • Provides a long-term storm drain solution for Willow Ln/Schroeder Ln area.
Technical Data:	25-yr design flows range from 2.8 to 54 cfs Water quality design flow is 7.3 cfs Water quality facility should be off-line with target pollutants of metals, nutrients and TSS.
Implementation Issues:	Possible utility relocations. Temporary traffic management of brief roadway closures will be required. Relatively deep excavations along entire project length (approx 10+ feet).
Capital Cost:	$ 1,329,529

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-9	Discussion
Problem Location:	Redwood Ave Culvert at Sand Creek
Problem Summary:	Insufficient culvert capacity results in roadway overtopping.
Alternative 1:	Upsize the existing culvert to large, countersunk, box structure.
Benefits:	• Eliminates roadway overtopping • Enhances fish passage
Technical Data:	25-yr design flow is 629 cfs.
Implementation Issues:	Temporary roadway closure of Redwood Ave. Limited in-stream work period. Environmental permits required.
Capital Cost:	$ 216,956

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-10	Discussion
Problem Location:	Kokanee Ln, Yellowtail Ln and surrounding areas.
Problem Summary:	Insufficient drainage capacity along Kokanee Ln produces significant flooding and surcharging throughout the neighboring residential subdivisions.
Alternative 1:	Upsize the existing storm drain pipe along Kokanee Ln and west along Leonard Rd.
Benefits:	• Eliminates surface flooding and reduces surcharging • All construction activities in public right-of-way and within Urban Growth Boundary
Technical Data:	25-yr design flows range from 2 to 31 cfs
Implementation Issues:	Temporary traffic controls and/or roadway closures along Kokanee Ln and Leonard Rd. Significant roadway repairs and resurfacing. Possible utility relocations.
Capital Cost:	None developed
Alternative 2:	Upsize storm drain pipe along Kokanee Ln. between Mary Lynn Ln. and Raydean Dr. Divert flows at Kokanee Ln and Raydean Dr. west and then north through a new storm drain and channel system to a detention/water quality facility at the southeast corner of the Leonard Rd and Darneille Rd intersection.
Benefits:	• Eliminates flooding and surcharging in the surrounding areas. • Eliminates the need to replace a significant portion of the existing storm drain infrastructure. • Provides surface water quality treatment and reduces pollutant loads that are generated from existing and future residential developments.
Technical Data:	25-yr design flow entering pond is 16.6 cfs. Peak water quality flow is 2.3 cfs and required treatment volume is 2.6 ac-ft. Pond should have an off-line water quality cell to avoid re-suspension.
Implementation Issues:	Will require brief periods of temporary traffic control and/or road closures along Kokanee Ln and possibly Darneille Ln and Leonard Rd. May require wetland permitting including a determination/delineation and mitigation. Will require approximately 1.0 acres of new land acquisition.
Capital Cost:	$ 1,340,000
***Alternative 3:**	Upsize storm drain pipe along Kokanee Ln. between Mary Lynn Ln. and Raydean Dr. Divert flows at Kokanee Ln and Raydean Dr. west and then north through a new storm drain and channel system to a water quality swale upstream of the delineated wetland on the Lowe Subdivision. Discharge from the water quality swale is to be conveyed through the wetland within the limits of the wetland boundary. Construct approximately 220’ of new 30” pipe segment between end of swale and Leonard Rd. Replace the existing pipe segment along Leonard Rd between swale connection and the Darneille Rd intersection with an upsized 30” pipe.
Benefits:	• Eliminates flooding and surcharging in the surrounding areas • Eliminates the need to replace a significant portion of the existing storm

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-10	Discussion
	drain infrastructure • Provides surface water quality treatment and reduces pollutant loads that are generated from existing and future residential developments. • Eliminates conflicts with the Lowe Subdivision plan
Technical Data:	25-yr design flow entering pond is 16.6 cfs. Peak water quality flow in swale is 2.3 cfs with a minimum residence time of 10 minutes.
Implementation Issues:	Will require brief periods of temporary traffic control and/or road closures along Kokanee Ln, Leonard Rd and possibly Darneille Ln. May require wetland permitting including a determination/delineation. Depending on current or planned wetland easements, may require approximately 0.5 acres of new land acquisition.
Capital Cost:	$ 847,465

* Indicates the recommended alternative

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-11	Discussion
Problem Location:	Drainage culvert at north end of Coutant Ln.
Problem Summary:	Insufficient culvert capacity results in roadway overtopping.
Alternative 1:	Upsize the existing culvert.
Benefits:	• Eliminates roadway overtopping
Technical Data:	25-yr design flow is 160 cfs.
Implementation Issues:	Temporary roadway closure of Coutant Ln. Additional permits may be required.
Capital Cost:	$ 118,367

TABLE 8.2-1
Alternatives Analysis Summary
Grants Pass: Sand Creek Basin

SA-12	Discussion
Problem Location:	Elmer Nelson Road at Sand Creek
Problem Summary:	Insufficient culvert capacity results in roadway overtopping and flooding of adjacent properties.
Alternative 1:	Upsize the existing culvert to a 20’ x 6’ arch.
Benefits:	• Eliminates roadway overtopping and flooding
Technical Data:	25-yr design flow is 629 cfs.
Implementation Issues:	Temporary roadway closure of Elmer Nelson Road. Additional permits may be required. Culvert will need to be fish passable.
Capital Cost:	$ 144,048

8.2.2 Gilbert Creek Basin: Alternative Summary Tables

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-1	Discussion
Problem Location:	Lincoln Rd between Bridge Street and the Rogue River
Problem Summary:	Undersized pipe system causes localized flooding. No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	This alternative consists of upsizing and constructing several new pipe segments to accommodate peak runoff from the full build out land use scenario. New trunk pipe sizes range from 36" to 42". New pipes in the Lower River Meadows Subdivision are 12". This alternative also includes the addition of a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 107 cfs; Peak water quality flow is 15 cfs.
Implementation Issues:	Grades prevent connecting the Lower River Meadows Subdivision to the main trunk link on Lincoln Road. The remaining elements will require traffic control and possible short-term closing of Lincoln Road Probable utility conflicts.
Capital Cost:	None developed
***Alternative 2:**	This alternative consists of upsizing and constructing several new pipe segments to accommodate peak runoff from the full build out land use scenario. New pipe sizes range from 36" to 42". This alternative also includes the addition of a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 107 cfs; Peak water quality flow is 15 cfs.
Implementation Issues:	Will require traffic control and possible short-term closing of Lincoln Ave. Probable utility conflicts.
Capital Cost:	$ 958,909

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-1A	Discussion
Problem Location:	South end of Osprey Drive near the Rogue River
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Construct a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 4 cfs.
Implementation Issues:	Possible utility conflicts.
Capital Cost:	$ 89,694

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-2	Discussion
Problem Location:	South end of Spruce Street near the Rogue River
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Construct a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 14 cfs.
Implementation Issues:	Possible utility conflicts.
Capital Cost:	$ 137,207

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-3	Discussion
Problem Location:	South end of Greenwood Avenue near the Rogue River
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Divert flow from the trunk line on Spruce Street east to Greenwood Avenue and construct a single, combined water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment for two significant storm drain systems and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 26 cfs.
Implementation Issues:	Probable, significant utility conflicts in the adjacent wastewater treatment plant. Excessive cost to connect the two storm drain systems as compared to constructing two separate water quality manholes.
Capital Cost:	None developed
Alternative 2:	Construct a water quality pond at the downstream end of the system on existing city property to the southeast of Greenwood Avenue.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 12 cfs. Storage requirement: approx. 1.6 ac-ft.
Implementation Issues:	The depth of the existing storm drain (approx. 14') make constructing a surface water quality treatment system unpractical. Possible utility conflicts.
Capital Cost:	None developed
***Alternative 3:**	Construct a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 12 cfs.
Implementation Issues:	Possible utility conflicts.
Capital Cost:	$ 112,922

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-4	Discussion
Problem Location:	Lincoln Road south of “G” Street
Problem Summary:	Lincoln Road is in sag condition approximately 600 feet south of “G” Street and the existing wetland draining to the west often overtops the roadway.
Alternative 1:	Extend the existing storm drain system north along Lincoln Road to intercept excess runoff and alleviate flooding.
Benefits:	• Reduced the frequency of flooding and roadway overtopping along Lincoln Road.
Technical Data:	n/a
Implementation Issues:	Possible utility conflicts. Traffic control. Will require wetland permitting. Does not significantly reduce flooding. May cause system capacity problems further downstream (south) on Lincoln Road.
Capital Cost:	None developed
***Alternative 2:**	Raise Lincoln Road by approximately 2 feet to prevent flooding and install 3 new 48” culverts to maintain an east-west connection for the wetland.
Benefits:	• Reduced the frequency of flooding and roadway overtopping along Lincoln Road.
Technical Data:	n/a
Implementation Issues:	Possible utility conflicts. May require closing Lincoln Road and detouring traffic, or longer-term traffic control. Will require wetland permitting. May required wetland mitigation if roadway footprint expands due to increased height.
Capital Cost:	$ 1,296,515

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-5	Discussion
Problem Location:	Greenwood Avenue, "L" Street, Alder Street and "I" Street south of Upper River Road
Problem Summary:	Undersized pipe system causes localized flooding.
Alternative 1:	This alternative consists of upsizing several pipe segments to accommodate peak runoff from the full build out land use scenario. New pipe sizes range from 30" to 42".
Benefits:	• Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 22 cfs (upstream), 63 cfs (downstream);
Implementation Issues:	Will require traffic control and possible short-term closing of all four streets as well as Upper River Road, Bridge Street and Rogue River Ave. Probable utility conflicts.
Capital Cost:	$ 969,566

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-6	Discussion
Problem Location:	Oak Street between "J" Street and Burgess Street
Problem Summary:	Undersized pipe and high water levels in Gilbert Creek system causes localized flooding.
Alternative 1:	This alternative consists of upsizing several pipe segments to reduce flooding in the surrounding neighborhood. Flooding is not completely eliminated in this alternative due to the backwater caused by high flows in Gilbert Creek. New pipe size is 24".
Benefits:	• Reduces flooding and surcharging potential at various locations along the drainage system
Technical Data:	25-yr design flow: 16 cfs Water quality manholes were not considered a viable solution for this outfall because the hydraulic grade line would regularly flood the facility diminishing its performance.
Implementation Issues:	Will require traffic control and possible short-term closures of Oak Street and the connecting side streets. Probable utility conflicts.
Capital Cost:	$ 255,410

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-7	Discussion
Problem Location:	3rd Street between "F" Street and Gilbert Creek
Problem Summary:	Undersized pipe and high water levels in Gilbert Creek system causes surcharging and localized flooding.
Alternative 1:	This alternative consists of upsizing several pipe segments to reduce flooding in the surrounding neighborhood. Flooding and surcharging is not completely eliminated in this alternative due to the backwater caused by high flows in Gilbert Creek. New pipe size is 30".
Benefits:	• Reduces flooding and surcharging potential at various locations along the drainage system
Technical Data:	25-yr design flow: 25 cfs Water quality manholes were not considered a viable solution for this pipe because the hydraulic grade line would likely flood the facilities diminishing its performance.
Implementation Issues:	Will require traffic control and possible short-term closures of 3rd Street and the connecting side streets. This drainage line also passes beneath the Central Oregon & Pacific Railroad, which will require additional design and construction measures to be included. Probable utility conflicts.
Capital Cost:	$ 195,322

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-8	Discussion
Problem Location:	5th Street between "G" Street and "M" Street
Problem Summary:	The existing 12" clay pipe is undersized causing localized flooding and surcharging in the drainage system. Additionally, the clay pipe and brick manholes may be near or at the limit of their usable life.
Alternative 1:	This alternative consists of replacing the existing clay pipe with a new storm drain system ranging in size from 24" to 30" in diameter.
Benefits:	• Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 16 cfs
Implementation Issues:	Will require traffic control and possible short-term closures of 5th Street and the connecting side streets. Probable utility conflicts given the location in downtown Grants Pass.
Capital Cost:	$ 528,351

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-9	Discussion
Problem Location:	9^{th} Street between "I" Street and "M" Street
Problem Summary:	The existing storm drain system is undersized causing localized flooding, surcharging and gutter flow in the surrounding neighborhoods.
Alternative 1:	This alternative consists of replacing the existing pipe with a new 24" storm drain system.
Benefits:	• Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 23 cfs;
Implementation Issues:	Will require traffic control and possible short-term closures of 9^{th} Street and the connecting side streets. Probable utility conflicts given the location in downtown Grants Pass.
Capital Cost:	$ 372,953

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-10	Discussion
Problem Location:	"M" Street between 5th Street and 9th Street and the south end of 8th Street near the Rogue River
Problem Summary:	No water quality treatment is provided in the existing storm drain system, which given the heavy commercial land use type, results in elevated pollutant loads.
Alternative 1:	Construct diversion weirs in existing manholes at the intersection of "M" Street with 5th, 6th and 7th Streets to divert low flows (water quality flows) to a newly constructed water quality manhole at the south end of 8th Street where flows will be discharged to the Rogue River
Benefits:	• Provides water quality treatment for a major portion of the commercial areas of downtown Grants Pass south of the railroad tracks
Technical Data:	Peak water quality flow is 17 cfs.
Implementation Issues:	Will require some traffic control and possible short-term closures along "M" Street and the connecting numbered streets. Diversion weirs may be constructed at night to minimize traffic conflicts. Probable utility conflicts given the location in downtown Grants Pass.
Capital Cost:	None developed
***Alternative 2:**	Construct diversion weirs in existing manholes at the intersection of "M" Street with 5th, 6th and 7th Streets to divert low flows (water quality flows) to a newly constructed water quality manhole at the south end of 8th Street where flows will be discharged to the Rogue River. Construct a new 12" storm drain that connects the 9th Street storm drain conduit to the water quality manhole.
Benefits:	• Provides water quality treatment for nearly all of the commercial areas of downtown Grants Pass south of the railroad tracks
Technical Data:	Peak water quality flow is 21 cfs.
Implementation Issues:	Will require some traffic control and possible short-term closures along "M" Street and the connecting numbered streets. Diversion weirs may be constructed at night to minimize traffic conflicts. Probable utility conflicts given the location in downtown Grants Pass.
Capital Cost:	$ 582,813

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-11	Discussion
Problem Location:	Grant Street and “B” Street at base of western hill slope
Problem Summary:	Undersized pipe system and inlet cause localized flooding along Grant Street. According to city field operations staff, this is a reoccurring flood area.
Alternative 1:	Upsize existing storm drain system along Grant Street and “B” Street to its outfall at Gilbert Creek.
Benefits:	• Eliminates flooding along Grant Street and downstream along “B” Street
Technical Data:	25-yr design flow is 142 cfs.
Implementation Issues:	Will require some traffic control and possible short-term closures along “B” Street, Grant Street and the connecting perpendicular streets. Probable utility conflicts given the location near downtown Grants Pass.
Capital Cost:	None developed
***Alternative 2:**	Construct a 1.0 ac-ft detention pond/sedimentation trap immediately upstream of the inlet to the existing storm drain system.
Benefits:	• Helps to eliminates flooding along Grant Street and downstream along “B” Street • In combination with the other proposed detention facilities, eliminates overtopping of the downstream culverts on Gilbert Creek and significantly reduces overall channel capacity problems in the lower part of the basin. • In combination with the other proposed detention facilities, reduces channel velocities in Gilbert Creek thus reducing stream bank erosion and channel incision. • Provides a location to remove sediments from the runoff prior to entering the piped system.
Technical Data:	25-yr outlet design flow is 68 cfs. Storage requirement: approx. 1.0 ac-ft.
Implementation Issues:	Will require land acquisition. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated material. Will require new permanent access.
Capital Cost:	$ 297,427

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-12	Discussion
Problem Location:	Hillcrest Ave and 7th Street
Problem Summary:	The existing storm drain system is undersized causing localized flooding, surcharging and gutter flow in the surrounding streets.
Alternative 1:	This alternative consists of replacing the existing pipe with a new storm drain system ranging in size from 18" to 24" in diameter.
Benefits:	• Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 14 to 27 cfs;
Implementation Issues:	Will require traffic control and possible short-term closures of 7th Street and Hillcrest Avenue. Probable utility conflicts.
Capital Cost:	$ 308,674

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-13	Discussion
Problem Location:	West end of Hillcrest Avenue at Gilbert Creek
Problem Summary:	No water quality treatment is currently being provided for the commercial areas along 6th and 7th Streets prior to discharge to Gilbert Creek.
Alternative 1:	Construct a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 13 cfs.
Implementation Issues:	Possible utility conflicts and traffic control.
Capital Cost:	$ 140,044

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-14	Discussion
Problem Location:	Highland Avenue between Starlite Place and Savage Street.
Problem Summary:	No storm drain system exists along lower Starlite Place, Highland Drive and Savage Street. During significant storm events, street flooding is experienced in a sag along Highland Drive. During large events, canal overtopping would results in more severe street flooding.
Alternative 1:	Construct a new 30” storm drain system along Highland Drive from just north of Starlite Place to Savage Street. Construct a new 30” storm drain along Savage Street to discharge to Gilbert Creek.
Benefits:	• Eliminates flooding potential along Highland Drive • Provides sufficient capacity for upland development • Relieves flows that may otherwise enter the Tokay Canal and cause flooding problems to the west in the Blue Gulch area.
Technical Data:	25-yr design flow: 25 cfs;
Implementation Issues:	Will require traffic control and possible short-term closures of lower Starlite Place, Highland Avenue and Savage Street. Probable utility conflicts. Possible deep excavations (10’) at intersection of Highland Drive and Savage Street.
Capital Cost:	$ 588,427

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-14A	Discussion
Problem Location:	Starlite Place and the Blue Gulch Area
Problem Summary:	The existing storm drain system along Starlite Drive discharges uncontrolled runoff directly to the Blue Gulch area
Alternative 1:	This alternative consists constructing several new storm drain pipes from Starlite Place to the open channel in the Blue Gulch area. This alternative also includes construction of a new collection system along Starlite Place between the proposed connections to the Blue Gulch Area
Benefits:	• Eliminates uncontrolled stormwater discharge onto the slopes of the Blue Gulch area where development is likely to occur.
Technical Data:	Pipe slope: ~ 20% Pipe diameter: ~ 12”
Implementation Issues:	Pipe to be constructed on steep slopes and would required specialized anchor blocks as well as fusible pipe. Will require traffic control and possible short-term closures of Starlite Place. This project is to be address by the development community as part of the Blue Gulch expansion.
Capital Cost:	None developed
***Alternative 2:**	This alternative consists of constructing a new storm drain system along Starlite Place east to Highland Avenue.
Benefits:	• Eliminates uncontrolled stormwater discharge onto the slopes of the Blue Gulch area where development is likely to occur. • Does not require specialized construction along steep slopes of the Blue Gulch area.
Technical Data:	Pipe diameter: ~ 12” -18”
Implementation Issues:	Will require traffic control and possible short-term closures of Starlite Place. Improvement G-14 will need to be constructed before this project. This project is to be address by the development community as part of the Blue Gulch expansion.
Capital Cost:	$ 1,109,029

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-14B	Discussion
Problem Location:	Blue Gulch Area
Problem Summary:	New development in the Blue Gulch area has the potential to increase runoff by more than 100% causing downstream capacity problems along “B” Street.
Alternative 1:	Construct two regional detention facilities at the base of the Blue Gulch area.
Benefits:	• Provides flood protection for the areas immediately downstream. • Eliminates the need to upsize the storm drain system along “B” Street. • Provides water quality treatment. • Reduces sediment and debris that would otherwise collect in the “B” Street storm drain.
Technical Data:	Storage requirement: approx. 20.0 ac-ft. (7.5 ac-ft in the lower pond and 12.5 ac-ft in the upper pond)
Implementation Issues:	Will require land acquisition. May require significant haul of excavated (or fill) material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	$ 2,579,046

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-15	Discussion
Problem Location:	On either side of Gilbert Creek at Morgan Lane
Problem Summary:	No water quality treatment is currently being provided for either the commercial areas east of Gilbert Creek between the Interstate and Morgan Lane or the residential areas to the west of Gilbert Creek.
Alternative 1:	Construct two water quality manholes at the downstream end of each piped system prior to the existing outfall structures to Gilbert Creek.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter Gilbert Creek.
Technical Data:	For the residential areas to the west, peak water quality flow is 16 cfs. For the commercial/industrial areas to the east, peak water quality flow is 26 cfs.
Implementation Issues:	Possible utility conflicts and traffic control. Possible water table conflicts with water quality manhole.
Capital Cost:	$ 280,089

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-16	Discussion
Problem Location:	The open channel within the mobile home park east of Highland Drive and north or Windsor Drive
Problem Summary:	Surface flooding due to the under capacity channel is not uncommon for the trailers immediately adjacent to the channel.
Alternative 1:	Construct a regional detention facility upstream of the trailer park and Highland Avenue.
Benefits:	• Alleviates local flooding of trailer park and along Highland Avenue. (i.e. eliminates need or improvement G-19 and alternative 2, below)
Technical Data:	Storage requirement: approx. 15.0 ac-ft.
Implementation Issues:	Will require significant land acquisition. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	None developed
Alternative 2:	Construct an expanded open channel system within the trailer park.
Benefits:	• Alleviates local flooding of trailer park • Provides a cost effective solution as compared to a large regional detention facility which requires significant and costly land acquisition.
Technical Data:	25-yr design flow: 170 cfs; Approximate channel dimensions: 4’ bottom wide, 3:1 side slopes, 4’ deep.
Implementation Issues:	Will require land acquisition or an expanded drainage easement. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	$ 292,224

* Indicates the recommended alternative

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-17	Discussion
Problem Location:	Morgan Lane between Wendy Way and Candler Avenue. Cooke Avenue between Crown Street and Candler Avenue
Problem Summary:	The existing storm drain system is undersized causing localized flooding, surcharging and gutter flow in the surrounding streets.
Alternative 1:	This alternative consists of upsizing two pipe segments with a new storm drain system ranging in size from 18” to 24” in diameter.
Benefits:	• Eliminates localized flooding potential.
Technical Data:	25-yr design flow: 19 cfs and 25 cfs for the Cook Avenue and Morgan Lane Pipes respectively.
Implementation Issues:	Will require traffic control and possible short-term closures of Morgan Lane and Cooke Avenue. Probable utility conflicts.
Capital Cost:	$ 276,079

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-17A	Discussion
Problem Location:	Valley View Drive between Candler Avenue and the Tokay Canal.
Problem Summary:	Runoff above the Tokay Canal is currently being directed into the canal causing capacity problems downstream.
Alternative 1:	This alternative consists of constructing a new 12” storm drain to disconnect runoff along Valley View Road from the Tokay Canal.
Benefits:	• Eliminates localized flooding potential. • Reduces urban runoff being directed to the irrigation canal system.
Technical Data:	25-yr design flow: 14 cfs
Implementation Issues:	Will require traffic control and possible short-term closures of Valley View Lane. Probable utility conflicts.
Capital Cost:	$ 98,556

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-18	Discussion
Problem Location:	The vacant parcel immediately south of the Interstate and east of Gilbert Creek. South of Vine Street and East of Wintergreen Lane.
Problem Summary:	Peak flows in the lower portion of Gilbert Creek result in overtopping of 6 culverts between “A” Street and Bridge Street. An additional 3 culverts also have insufficient capacity causing the road subgrade to be inundated.
Alternative 1:	Construct a 22.8 ac-ft detention pond on the east side of Gilbert Creek in the vacant lot immediately south of the Interstate. (Other possible pond locations exist immediately to the north of Interstate-5 as shown on Figure 9.2-2).
Benefits:	• Eliminates overtopping of the downstream culverts on Gilbert Creek and significantly reduces overall channel capacity problems in the lower part of the basin. • Reduces channel velocities in Gilbert Creek thus reducing stream bank erosion and channel incision. • Could be constructed to provide localized water quality treatment for the runoff originating along the Interstate-5. • Provides flood detention of spills from the Demaray Canal.
Technical Data:	Storage requirement: approx. 22.8 ac-ft.
Implementation Issues:	Will require land acquisition. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated/fill material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	$ 1,392,674

TABLE 8.2-2
Alternatives Analysis Summary
Grants Pass: Gilbert Creek Basin

G-19	Discussion
Problem Location:	Highland Avenue near the Intersection with Vine Street
Problem Summary:	Undersized pipe system causes localized flooding.
Alternative 1:	This alternative consists of upsizing the existing 24” conduit to accommodate peak runoff from the full build out land use scenario. New pipe sizes is 36”.
Benefits:	• Eliminates flooding potential at various locations along the drainage system
Technical Data:	25-yr design flow: 143 cfs;
Implementation Issues:	Will require traffic control and possible short-term closing of Highland Ave. Possible improvements required to downstream conveyance system in mobile home park. Probable utility conflicts.
Capital Cost:	$ 147,721

8.2.3 Allen and Fruitdale Creek Basins: Alternative Summary Tables

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-1	Discussion
Problem Location:	Allen Creek at Redwood Highway and Redwood Ave
Problem Summary:	The long culvert under Redwood Highway is one of the major barriers to fish passage in Grants Pass. Roadway improvements in this area are also currently being considered.
Alternative 1:	This alternative consists of retrofitting the current culvert using baffles and/or grade control structures.
Benefits:	• Provides fish accessibility to upper Allen Creek • If permittable, would eliminate the cost of fully replacing the culvert.
Technical Data:	25-yr design flow: 846 cfs; 2-yr design flow: 415 cfs Fish passage design flow: 110 cfs[1]
Implementation Issues:	Specialized construction methods to work within the culvert are required. Will require coordination with ODOT. May require specific instream permits.
Capital Cost:	None developed.
***Alternative 2:**	This alternative consists of day-lighting Allen Creek in the areas immediately adjacent to Redwood Highway and Redwood Avenue and constructing new fish-passable culverts beneath the two roads.
Benefits:	• Provides fish accessibility to upper Allen Creek • A feasibility study is currently evaluating changes to the intersection of Redwood Highway and Redwood Ave. If ODOT decides to move forward with the project, there may be significant cost sharing opportunities available to complete this project.
Technical Data:	25-yr design flow: 846 cfs 25-yr approach flow depth: 4.0 ft Approx. channel width and culvert span: 20ft
Implementation Issues:	Will require significant excavation, traffic control and possible short-term closing of Redwood Ave. Specialized construction methods may be required to install culvert beneath Redwood Highway. Will require coordination with ODOT. Bank stability issues are likely due to the depth of the channel. Possible utility relocations.
Capital Cost:	$ TBD

* Indicates the recommended alternative

1. Fish passage design flow based on ODFW equation (Q=0.18*Q(2-yr)+32)

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-2	Discussion
Problem Location:	Redwood Highway between Allen Creek and Henderson Lane
Problem Summary:	No water quality treatment is currently being provided for the highway corridor and surrounding commercial areas
Alternative 1:	Construct a water quality manhole near the outlet of the fairgrounds storm drain system (northeast corner of the fairgrounds) to provide water quality treatment.
Benefits:	• Provides water quality treatment and reduces pollutant loads. • Reduces right-of-way requirements of other water quality treatment technologies like a center-median swale.
Technical Data:	ODOT water quality design criteria will be required to size facility. The tributary area for this water quality manhole is estimated to be approximately 80 acres. Peak water quality flow is 8.5 cfs.
Implementation Issues:	Will require significant traffic control of Redwood Highway. Will require coordination with ODOT. Possible utility relocations.
Capital Cost:	None developed
***Alternative 2:**	Construct/retrofit a water quality swale within the highway median.
Benefits:	• Provides water quality treatment and reduces pollutant loads. • Serves to treat a significant length of the Highway using existing open space in the right-of-way. • Utilizes an existing median for water quality treatment.
Technical Data:	ODOT water quality design criteria will be required to size facility. The tributary area for this swale is estimated to be 15 acres.
Implementation Issues:	Will require significant traffic control of Redwood Highway. Will require coordination with ODOT. Temporary irrigation will be required for vegetation establishment.
Capital Cost:	$ 125,927

* Indicates the recommended alternative

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-3	Discussion
Problem Location:	Williams Highway between Morris Lane and Neamar Street and the existing overland flow channel and wetland areas draining to Allen Creek to the west.
Problem Summary:	Although a portion of the upland runoff in this area is intercepted by the Allen Creek Lateral, a significant portion continues to drain to a low spot in Williams Highway just north of Arroyo Drive. Flooding is predicted in the storm drain system in the Allen Creek and Whispering Meadows subdivision as well as the wetland areas to the immediate north.
Alternative 1:	Construct new storm drain system along Williams Highway to collect upland runoff. Construct a new culvert and drainage channel to convey the upland runoff through the existing wetland to Allen Creek. Preliminary pipe size recommendation is 30”.
Benefits:	• Provides water quality treatment. • A dedicated drainage way and easement would serve as a receiving channel and treatment facility for runoff from new developments in the surrounding areas. • The areas surrounding the wetland could serve as a mitigation site for other stormwater-related projects.
Technical Data:	Peak water quality flow is 14 cfs. Peak 25-year flow is 60 cfs.
Implementation Issues:	Possible utility relocations. Land Acquisition. Probable wetland mitigation. Traffic control and possible short term lane closures along Williams Highway.
Capital Cost:	$ 297,382

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-4	Discussion
Problem Location:	The storm drain outfall located at the west end of West Park Street.
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Construct a proprietary water quality treatment device at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 9.0 cfs.
Implementation Issues:	Possible utility relocations.
Capital Cost:	None developed
Alternative 2:	Construct a water quality pond at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 9.0 cfs. Storage requirement: approx. 1.2 ac-ft.
Implementation Issues:	Possible utility relocations. Land acquisition.
Capital Cost:	None developed
***Alternative 3:**	Construct a diversion manhole and pipe to redirect the water quality flows from the fairgrounds system outfall to the water quality pond described in Alternative 2.
Benefits:	• Provides water quality treatment and reduces pollutant loadings that would otherwise directly enter the Rogue River. • Provides water quality treatment of two outfalls at a single location.
Technical Data:	Peak water quality flow is 17.5 cfs.
Implementation Issues:	Possible utility relocations. Land acquisition.
Capital Cost:	$ 769,181

* Indicates the recommended alternative

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-5	Discussion
Problem Location:	Westholm Avenue south of Upper River Road
Problem Summary:	No water quality treatment is currently being provided for the commercial and residential areas north of Redwood Highway and West of 6th Street (Hwy 99) prior to discharge to the Rogue River.
Alternative 1:	Construct a water quality manhole at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 3 cfs. Peak 25-yr (bypass) flow is 37 cfs.
Implementation Issues:	Possible utility relocations and traffic control.
Capital Cost:	$ 92,531

TABLE 8.2-3
Alternatives Analysis Summary
Grants Pass: Allen Creek Basin

A-7	Discussion
Problem Location:	West of Allendale Elementary School to the West of Allen Creek
Problem Summary:	High flows in Allen Creek cause localized flooding between Redwood Highway and Ramsey Avenue.
Alternative 1:	Construct a 10 ac-ft regional detention facility in the upper reaches of the Allen Creek basin to provide flooding relief and reduce channel erosion in the lower portion of the basin. (Potential pond sites shown on Figure 9.2-3).
Benefits:	• Reduces flooding potential at various locations along Allen Creek • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Reduces channel velocities in Allen Creek thus reducing stream bank erosion and channel incision.
Technical Data:	Storage requirement: approx. 10.0 ac-ft.
Implementation Issues:	Will require significant land acquisition (approximately 2 acres). Due to the depth of the Allen Creek channel, will require significant excavation depths. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	None developed
***Alternative 2:**	Construct 2 regional detention ponds in the vicinity of Allen Creek and the South Highline Canal crossing. Pond 1 is located to the east of Allen Creek and downstream of the canal and would provide flow detention during flood events along the creek. Pond 2 is located adjacent to the canal and would provide peak flow attenuation during periods of high winter canal flows.
Benefits:	• Reduces flooding potential at various locations along Allen Creek • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Reduces channel velocities in Allen Creek thus reducing stream bank erosion and channel incision. • Attenuates high canal flows
Technical Data:	Combined storage requirement: approx. 10.0 ac-ft.
Implementation Issues:	May require some land acquisition. Due to the depth of the Allen Creek channel, will require significant excavation depths. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration. Will require coordination with GPID.
Capital Cost:	$ 1,795,778

* Indicates the recommended alternative

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-1	Discussion
Problem Location:	The storm drain outfall to the Rogue River located adjacent to 6th Street
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Construct a water quality pond to the west of 6th Street at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 3.5 cfs. Storage requirement: approx. 1.4 ac-ft.
Implementation Issues:	Possible utility relocations. Property acquisition may be costly or difficult to obtain.
Capital Cost:	None developed
Alternative 2:	Construct a regional water quality pond between 6th and 7th Streets immediately south of the Rogue River.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Provides water quality treatment of two drainage outfalls at a single location.
Technical Data:	Peak water quality flow is 19.2 cfs. Storage requirement: approx. 3.2 ac-ft.
Implementation Issues:	Possible utility relocations. Property acquisition may be costly or difficult to obtain.
Capital Cost:	$ 174,962
***Alternative 3:**	Construct a water quality manhole at the north end of 7th Street to treat the existing 30" storm drain prior to discharge to the Rogue River. Construct a water quality manhole and associated diversion piping to treat the 2 existing 15" storm drain lines along 6th Street in a single location prior to discharge into the Rogue River.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Minimizes land acquisition requirements. • Treats three storm drain lines with two water quality manholes.
Technical Data:	Peak water quality flow along 7th Street is 16.7 cfs. Peak water quality flow along 6th Street is 3.5 cfs.
Implementation Issues:	Possible utility relocations.
Capital Cost:	$ 222,660

* Indicates the recommended alternative

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-2	Discussion
Problem Location:	The storm drain outfall to the Rogue River located adjacent to 7th Street
Problem Summary:	No water quality treatment is currently being provided prior to discharge to the Rogue River.
Alternative 1:	Construct a water quality manhole to the west of 6th Street at the downstream end of the system.
Benefits:	• Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	Peak water quality flow is 13 cfs. Peak 25-yr (bypass) flow is 113 cfs.
Implementation Issues:	Possible utility relocations. Deep excavation.
Capital Cost:	None developed
***Alternative 2:**	See F-1, Alternative 3

* Indicates the recommended alternative

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-3	Discussion
Problem Location:	Highway 199 storm drain between Playford Lane to the east and Ready Street to the north and west.
Problem Summary:	The existing storm drain is undersized causing localized flooding and surcharging along and upstream of Highway 199.
Alternative 1:	This alternative consists of upsizing the existing system with a 36" storm drain and incorporating a surface water quality facility in the open right-of-way adjacent to the north bound off ramp of Highway 199.
Benefits:	• Eliminates flooding potential at various locations along the drainage system • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River.
Technical Data:	25-yr design flow: 58 cfs; Peak water quality flow is 13.2 cfs. Water quality storage requirement: approx. 2.4 ac-ft.
Implementation Issues:	Site topography, adjacent pipe grades and the relatively low elevation of the northbound underpass make site grading and pond function difficult. Will require traffic control along Highway 99 and Highway 199 and possible short-term closures of Sunset Way and the connecting side streets. Probable utility relocations.
Capital Cost:	None developed
***Alternative 2:**	This alternative consists of upsizing the existing system with a 36" storm drain.
Benefits:	• Eliminates flooding potential at various locations along the drainage system. • The water quality improvements identified in projects F-1 and F-2 could be combined with this project.
Technical Data:	25-yr design flow: 58 cfs;
Implementation Issues:	Will require traffic control along Highway 99 and Highway 199 and possible short-term closures of Sunset Way and the connecting side streets. Probable utility relocations.
Capital Cost:	$ 784,360

* Indicates the recommended alternative

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-4	Discussion
Problem Location:	Southridge Way and West Harbeck between Southridge Way to the North and Skyline Dr to the South.
Problem Summary:	The existing storm drain system is undersized causing localized flooding, surcharging and excessive gutter flow in the surrounding neighborhoods. No water quality treatment is currently being provided prior to discharge to the South Main Canal.
Alternative 1:	This alternative consists of replacing the existing pipe with a 24" storm drain along West Harbeck Road and an 18" pipe along Southridge Way. This alternative also includes retrofitting the existing roadside ditch along West Harbeck Road into a water quality swale to treat stormwater runoff prior to discharge to the South Main Canal.
Benefits:	• Eliminates flooding potential at various locations along the drainage system • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River via the South Main Canal and Allen Creek. • Utilizes existing public right-of-way for stormwater quality treatment.
Technical Data:	25-yr design flow: 23 to 39 cfs along West Harbeck Road and 9 cfs along Southridge Way. Water quality flow is 5.0 cfs.
Implementation Issues:	Will require traffic control and possible short-term closures of West Harbeck Road and Southridge Way and the connecting side streets. Probable utility relocations.
Capital Cost:	$ 410,603

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-5	Discussion
Problem Location:	The vacant parcel immediately south of the Rogue River between Grants Pass Parkway and E. Park Street.
Problem Summary:	No water quality treatment is being provided for the existing storm drain systems along Park Drive and Parkdale Drive.
Alternative 1:	This alternative consists of constructing a joint water quality pond to treat both storm drain systems prior to discharge to the Rogue River.
Benefits:	• Provides water quality treatment at a single location prior to discharge into the Rogue River.
Technical Data:	Peak 25-yr bypass flow: 38 to 89 cfs (Park Drive and Parkdale Drive systems). Peak water quality flow is 16 cfs. Storage requirement: approx. 3.2 ac-ft.
Implementation Issues:	Will require traffic control and possible short-term closures of E. Park Street and the connecting side streets. Possible land acquisition. This site is currently being considered for a new fire station, which would preclude a large surface treatment pond.
Capital Cost:	$ 319,833
***Alternative 2:**	This alternative consists of constructing a joint water quality manhole to treat both storm drain systems prior to discharge to the Rogue River.
Benefits:	• Provides water quality treatment at a single location prior to discharge into the Rogue River.
Technical Data:	Peak 25-yr bypass flow: 38 to 89 cfs (Park Drive and Parkdale Drive systems). Peak water quality flow is 16 cfs.
Implementation Issues:	Will require traffic control and possible short-term closures of E. Park Street and the connecting side streets. Possible land acquisition. Allows for the site to be used for the new fire station, without significant impact.
Capital Cost:	$ 238,578

* Indicates the recommended alternative

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-6	Discussion
Problem Location:	The existing culvert on Fruitdale Creek at Fruitdale Drive
Problem Summary:	The culvert is under capacity. This is a known problem area and roadway overtopping is not uncommon.
Alternative 1:	This alternative consists of replacing the existing culvert with a 20' x 7' bottomless arch culvert.
Benefits:	• Eliminates flooding and roadway overtopping • Improves fish passage in the Fruitdale Creek basin
Technical Data:	25-yr design flow: 978 cfs; 2-yr design flow: 455 cfs Fish passage design flow: 114 cfs[1]
Implementation Issues:	Possible utility relocations. Will require traffic control and short-term closures of Fruitdale Drive. May require specific instream permits.
Capital Cost:	$ 328,314

1. Fish passage design flow based on ODFW equation (Q=0.18*Q(2-yr)+32)

TABLE 8.2-4
Alternatives Analysis Summary
Grants Pass: Fruitdale Creek Basin

F-7	Discussion
Problem Location:	East of Fruitdale Creek, north of the South Highline Canal and East of Panoramic Loop.
Problem Summary:	High flows in Fruitdale Creek cause localized flooding and culvert overtopping in the Fruitdale Drive area.
Alternative 1:	Construct a series of 3 detention ponds totaling 20 ac-ft in the upper watershed (outside of the UGB) to provide flooding relief and reduce channel erosion in the lower portion of the basin. (Potential pond sites shown on Figure 9.2-3).
Benefits:	• Reduces flooding potential at various locations along Fruitdale Creek • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Reduces channel velocities in Fruitdale Creek thus reducing stream bank erosion and channel incision.
Technical Data:	Storage requirement: approx. 20.0 ac-ft.
Implementation Issues:	Will require significant land acquisition (approximately 4 acres). Due to the relative depth of the Fruitdale Creek channel, will require significant excavation depths. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	None developed
***Alternative 2:**	Construct a 20 ac-ft regional detention facility in the upper reaches of the Fruitdale Creek basin to provide flooding relief and reduce channel erosion in the lower portion of the basin.
Benefits:	• Reduces flooding potential at various locations along Fruitdale Creek • Provides water quality treatment and reduces pollutant loads that would directly enter the Rogue River. • Reduces channel velocities in Fruitdale Creek thus reducing stream bank erosion and channel incision.
Technical Data:	Storage requirement: approx. 20.0 ac-ft.
Implementation Issues:	Will require significant land acquisition (approximately 4 acres). Due to the relative depth of the Fruitdale Creek channel, will require significant excavation depths. May have localized wetland issues/mitigation requirements. May require dewatering during construction. Will require significant haul of excavated material. Will require new permanent access. May require specific instream permits depending on inlet/outlet structure configuration.
Capital Cost:	$ 2,951,252

* Indicates the recommended alternative

8.2.4 Skunk and Jones Creek Basins: Alternative Summary Tables

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-1	Discussion
Problem Location:	The existing storm drain between 6th Street and 9th Street and between Manzanita Avenue and Steiger Street
Problem Summary:	Spillage originating in the Demarey Canal and the Tokay Canal and leaving via a 36” storm drain, eventually enters an undersized 24” storm drain system, resulting in localized flooding adjacent to the undersized pipe and channel segments.
Alternative 1:	This alternative consists of replacing the undersized pipe segments with 36” conduit and improving/upsizing the open channel and roadside ditch segments.
Benefits:	Alleviates localized flooding associated with canal spillage.
Technical Data:	25-yr design flow(s): 69 - 100 cfs; Approx. channel dimensions: 4ft bottom width, 4ft deep, min. 2:1 (H:V) side slopes
Implementation Issues:	Possible utility relocations. Traffic control and possible short-term lane closures along Overlook Avenue, 7th Street, 9th Street and Savage Street.
Capital Cost:	$ 544,776

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-2	Discussion
Problem Location:	Savage Street between 10th Street and east of Evans Street
Problem Summary:	Overflow from the Demarey and the Tokay Canals drains via spill points to a single, undersized storm drain along Savage Street.
Alternative 1:	Replace the existing 24” storm drain with a 36” pipe.
Benefits:	Alleviates localized flooding associated with canal overflows.
Technical Data:	25-yr design flow: 104 cfs
Implementation Issues:	Possible utility relocations. Traffic control and possible short term lane closures along Savage Street.
Capital Cost:	$ 136,322

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-3	Discussion
Problem Location:	The open channel immediately east of Croxton Avenue between Madrone Street and Cedar Street.
Problem Summary:	The existing storm drain pipe immediately downstream of the open channel system east of Croxton Avenue is undersized resulting in upstream flooding. Moreover, heavy vegetation in the open channel reach further exasperates flooding by restricting channel conveyance capacity. Additionally, no water quality treatment is being provided for this residential basin which ultimately discharges to the River.
Alternative 1:	Upsize the undersized pipe segment and replace the existing natural channel with a new 48" pipe. Construct a water quality manhole at the intersection of "A" Street and Candy Lane.
Benefits:	• Alleviates localized flooding along Croxton Avenue. • Provides water quality treatment for the upstream drainage basin.
Technical Data:	Peak 25-year flow is 115 cfs. Peak water quality flow is 20 cfs.
Implementation Issues:	Possible utility relocations. Possible land acquisition or drainage easement acquisition. Possible mitigation. Potentially complex permitting associated with piping the existing channel. Traffic control and possible short term lane closures along Madrone Street and "A" Street.
Capital Cost:	None developed
***Alternative 2:**	Abandon the existing storm drain under the high school athletic fields and construct a new 36" storm drain that ties into the existing stub out along Madrone Ave. Additionally, enhance/widen the existing natural channel to accommodate peak flow rates. Construct a water quality manhole at the intersection of "A" Street and Candy Lane.
Benefits:	• Alleviates localized flooding along Croxton Avenue. • Provides water quality treatment for the upstream drainage basin
Technical Data:	Peak 25-year flow is 115 cfs. Approx. channel dimensions: 4ft bottom width, 4ft deep, min. 2:1 (H:V) side slopes Peak water quality flow is 20 cfs.
Implementation Issues:	Possible utility relocations. Possible land acquisition or drainage easement acquisition. Permitting associated with in-stream improvements. Traffic control and possible short term lane closures along Madrone Street and "A" Street.
Capital Cost:	$ 378,626

* Indicates the recommended alternative

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-4	Discussion
Problem Location:	"A" Street between Beacon Drive and Elida Drive.
Problem Summary:	Hydraulic deficiencies downstream in the Mill Street drainage cause widespread backups in the adjoining storm drain, including "A" Street.
Alternative 1:	Improvements to the S-5 problem location remedy flooding in this location. See improvement S-5 Summary table.
Benefits:	See improvement S-5.
Technical Data:	See improvement S-5.
Implementation Issues:	See improvement S-5.
Capital Cost:	None developed

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-5	Discussion
Problem Location:	The Mill Street channel system between Skunk Creek to the south and approximately "D" Street to the north.
Problem Summary:	The Mill Street drainageway, including both the channel and the numerous culverts, are severely under-capacity. The capacity problems include: 1) undersized culverts, 2) heavy vegetation, 3) an undersized channel shape, 4) a very flat channel slope and 5) siltation and debris clogging the channel and culverts.
Alternative 1:	This alternative provides a programmatic approach to improving the Mill Street major drainageway. Recommendations include: 1) enhancing and widening the existing channel between Skunk Creek and north of the Southern Oregon and Pacific Railroad crossing, 2) increasing the culvert capacity at each roadway and railroad crossing, 3) rerouting a portion of the contributing drainage area to different outfalls (see improvements S-12 and S-10), 4) installing an overflow bypass channel connecting the Mill Street system to Skunk Creek (along "A" Street), and 5) performing routine maintenance and cleaning of the existing channel from excessive vegetation, silt and debris buildup.
Benefits:	Improved capacity will dramatically impact flooding and surcharging of the drainageway itself and a significant portion of the contributing storm drain system.
Technical Data:	Peak 25-yr flows range from 160 cfs to 520 cfs. Approx. channel dimensions: 6-10ft bottom width, 5-8ft deep, min. 3:1 (H:V) side slopes
Implementation Issues:	Possible utility relocations. Possible land acquisition or drainage easement acquisition. Permitting for in-stream work. Traffic control and possible short term lane closures of streets crossing, or adjacent to, the channel. Coordination with the Southern Oregon and Pacific Railroad. Long-term project sequencing.
Capital Cost:	$ 318,812

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-6	**Discussion**
Problem Location:	The storm drain system along "D" Street between Sherwood Place and Baker Drive.
Problem Summary:	The slightly under capacity storm drain system combined with the hydraulic deficiencies downstream in the Mill Street drainageway result in localized flooding
Alternative 1:	Improvements to the S-5 problem location remedy flooding in this location. See improvement S-5 Summary table.
Benefits:	See improvement S-5.
Technical Data:	See improvement S-5.
Implementation Issues:	See improvement S-5.
Capital Cost:	None developed

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-7	**Discussion**
Problem Location:	The storm drain system along "D" Street between Sherwood Place and Baker Drive.
Problem Summary:	Surcharging in the slightly under capacity storm drain system is dramatically magnified by the hydraulic deficiencies downstream in the Mill Street drainageway resulting in localized flooding.
Alternative 1:	Improvements to the S-5 problem location remedy flooding in this location. See improvement S-5 Summary table.
Benefits:	See improvement S-5.
Technical Data:	See improvement S-5.
Implementation Issues:	See improvement S-5.
Capital Cost:	None developed

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-8	Discussion
Problem Location:	The storm drain system along Agness Avenue between NE "F" Street and Grants Pass Parkway.
Problem Summary:	Surcharging in the slightly under capacity storm drain system is magnified by the hydraulic deficiencies downstream in the Mill Street drainageway resulting in localized flooding.
Alternative 1:	Improvements to the S-5 problem location remedy flooding in this location. See improvement S-5 Summary table.
Benefits:	See improvement S-5.
Technical Data:	See improvement S-5.
Implementation Issues:	See improvement S-5.
Capital Cost:	None developed

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-9	Discussion
Problem Location:	The storm drain system along NE "F" Street and adjacent to the Southern Oregon and Pacific Railroad between Grants Pass Parkway to the west and Agness Avenue to the east.
Problem Summary:	The hydraulic deficiencies downstream in the Mill Street drainageway cause a backwater condition throughout this reach producing significant surcharging and localized flooding.
Alternative 1:	Improvements to the S-5 and S-12 problem locations remedy flooding in this location. See summary table for improvement S-5 and S-12.
Benefits:	See improvement S-5 and S-12.
Technical Data:	See improvement S-5 and S-12.
Implementation Issues:	See improvement S-5 and S-12.
Capital Cost:	None developed

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-10	Discussion
Problem Location:	The storm drain system along "M" Street between Grants Pass Parkway and the northern extension of Rogue Drive.
Problem Summary:	The hydraulic deficiencies downstream in the Mill Street drainageway cause a backwater condition throughout this reach producing significant surcharging and localized flooding.
Alternative 1:	This alternative disconnects the "M" Street storm drain system from the Mill Creek drainageway and reroutes it to the existing system and outfall on the western end of Rose Place. Due to the increased flows, the existing Rose Place system would be upsized to a 36" pipe. This alternative also incorporates a new water quality manhole at the west end of Rose Place.
Benefits:	• Eliminates flooding potential at various locations along "M" Street by removing the connection to the flooded Mill Street drainageway. • Reduces runoff entering the Mill Street drainageway, thus reduces the size of improvements needed within the Mill Street drainageway. • Provides water quality treatment for adjacent residential and industrial runoff.
Technical Data:	25-yr design flow is 52 cfs Water quality flow is 6.5 cfs.
Implementation Issues:	Will require traffic control and possible short-term closures of "M" Street and Rose Place and the connecting side streets. Possible utility relocations. Possible permitting associated with Rogue River outfall modification.
Capital Cost:	$ 664,891

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-11	Discussion
Problem Location:	The piped portion of Skunk Creek between Evelyn Avenue to the north and 6th Street to the south.
Problem Summary:	The existing pipe system is undersized causing localized surcharging and flooding.
Alternative 1:	This alternative consists of increasing the conveyance capacity by constructing a new parallel 36" storm drain. This alternative also incorporates a water quality manhole on 6th Street to provide treatment for the commercial and residential runoff entering Skunk Creek.
Benefits:	• Eliminates flooding potential at various locations along the drainage system • Augments existing infrastructure, rather than replacing it. • Provides water quality treatment prior to discharge into the open channel portion of Skunk Creek.
Technical Data:	Peak 25-yr design flow: 195 cfs. Peak water quality flow is 25 cfs.
Implementation Issues:	Will require traffic control and possible short-term closures of Evelyn Avenue, 6th Street and the connecting side streets. Probable utility relocations.
Capital Cost:	None developed
***Alternative 2:**	This alternative consists of increasing the conveyance capacity by constructing a new 3' x 5' box storm drain. This alternative also incorporates a water quality manhole on 6th Street to provide treatment for the commercial and residential runoff entering Skunk Creek.
Benefits:	• Eliminates flooding potential at various locations along the drainage system • Augments existing infrastructure, rather than replacing it. • Provides water quality treatment prior to discharge into the open channel portion of Skunk Creek • Reduces the number of utility conflicts created by a parallel storm drain.
Technical Data:	Peak 25-yr design flow: 195 cfs. Peak water quality flow is 25 cfs.
Implementation Issues:	Will require traffic control and possible short-term closures of Evelyn Avenue, 6th Street and the connecting side streets. Probable utility relocations.
Capital Cost:	$ 411,379

* Indicates the recommended alternative

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-12	Discussion
Problem Location:	The existing storm drain along Rogue Drive between the Rogue River and the South Oregon and Pacific Railroad tracks.
Problem Summary:	The hydraulic deficiencies downstream in the Mill Street drainageway cause a backwater condition throughout this reach producing significant surcharging and localized flooding.
Alternative 1:	This alternative involves constructing a bypass pipe along Milebank Road between the storm drain system along Grants Pass Parkway and the storm drain system along "M" Street.
Benefits:	• Reduces surface flooding and manhole surcharging along NE "F" Street. • Location provides a relatively short connection (as opposed to other locations) between the two storm drain systems (approx. 900 ft). • Partially eliminating upstream flows from entering the Mill Street drainageway benefits the various flooded and surcharge storm drains entering the Mill Street drainageway upstream.
Technical Data:	Peak 25-yr (bypass) flow is 29 cfs.
Implementation Issues:	Limited grade between the two storm drain systems reduces the effectiveness of the bypass. Possible utility relocations. Possible land acquisition or drainage easement acquisition. Will require traffic control and possible short-term closures of "M" Street and Milbank Road.
Capital Cost:	None developed
Alternative 2:	This alternative involves constructing a 36" bypass pipe along the south side of the Southern Oregon and Pacific Railroad from the existing open channel beneath the Grants Pass Parkway overpass to the northerly extension of Rogue Drive. Due to capacity constraints along the existing Rogue Drive system, a parallel 36" pipe is also needed between Rose Place and the Rogue
Benefits:	• Reduces surface flooding and manhole surcharging along NE "F" Street. • Location provides a relatively short connection (as opposed to other locations) between the two storm drain systems (approx. 900 ft). • Partially eliminating upstream flows from entering the Mill Street drainageway benefits the various flooded and surcharge storm drains entering the Mill Street drainageway upstream.
Technical Data:	Peak 25-yr flow ranges from 69 cfs (bypass) to 117 cfs.
Implementation Issues:	Limited grade between the two storm drain systems reduces the effectiveness of the bypass. Possible utility relocations. Possible land acquisition or drainage easement acquisition. May require casing pipe along the railroad to address lateral loadings. Will required coordination with the railroad. Will require traffic control and possible short-term closures of Rogue Drive.
Capital Cost:	None developed
Alternative 3:	This alternative consists of constructing a hydraulically parallel pipe along the northern extension of Rogue Drive to directly connect the "F" Street storm drain to the Rogue River. Due to capacity constraints along the existing Rogue Drive system, a parallel 36" pipe is also needed between Rose Place and the Rogue

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-12	Discussion
	River. A division manhole is also included in this alternative to divert low flows west to the existing storm drain on "M" Street. Improvement S-10 would then convey the diverted runoff to a water quality manhole prior to discharge to the river.
Benefits:	• Significantly reduces surface flooding and manhole surcharging along NE "F" Street. • Location provides sufficient grade such that the effectiveness of the bypass pipe is maximized. • Helps to reduce upstream flows from entering the under capacity Mill Street drainageway. • Reduces the water quality flow treated by improvement R-3, thus eliminating the need for multiple proprietary units constructed in parallel.
Technical Data:	Peak 25-yr flow ranges from 69 cfs (bypass) to 117 cfs.
Implementation Issues:	Possible utility relocations. Possible land acquisition or drainage easement acquisition. Will require traffic control and possible short-term closures of Rogue Drive and connecting side streets. May require specialized construction methods beneath the railroad. Grades between the proposed bypass pipe and the "M" Street storm drain make diverting the water quality flows unachievable.
Capital Cost:	None developed
***Alternative 4:**	This alternative consists of constructing a hydraulically parallel pipe along the northern extension of Rogue Drive to directly connect the "F" Street storm drain to the Rogue River. Due to capacity constraints along the existing Rogue Drive system, a parallel 36" pipe is also needed between Rose Place and the Rogue River.
Benefits:	• Significantly reduces surface flooding and manhole surcharging along NE "F" Street. • Location provides sufficient grade such that the effectiveness of the bypass pipe is maximized. • Helps to reduce upstream flows from entering the under capacity Mill Street drainageway.
Technical Data:	Peak 25-yr flows range from 69 cfs (bypass) to 117 cfs.
Implementation Issues:	Possible utility relocations. Possible land acquisition or drainage easement acquisition. Will require traffic control and possible short-term closures of Rogue Drive and connecting side streets. May require specialized construction methods beneath the railroad.
Capital Cost:	$ 1,274,144

* Indicates the recommended alternative

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-13	Discussion
Problem Location:	The storm drain system along "D" Street between 12th Street and Foothills Boulevard
Problem Summary:	The hydraulic deficiencies downstream in the Mill Street drainageway cause a backwater condition throughout this reach producing significant surcharging and localized flooding.
Alternative 1:	Improvements to the S-5 problem location remedy flooding in this location. See improvement S-5 Summary table.
Benefits:	See improvement S-5.
Technical Data:	See improvement S-5.
Implementation Issues:	See improvement S-5.
Capital Cost:	None.

TABLE 6.2.4-1
Alternatives Analysis Summary
Grants Pass: Jones Creek Basin

S-14	Discussion
Problem Location:	Adjacent to the Tokay Canal and immediately north of the Interstate-5 interchange at Grants Pass Parkway
Problem Summary:	Localized flooding is experienced at various spill points along the Tokay Canal and at numerous locations in the downstream storm drain system.
Alternative 1:	This alternative involves constructing a detention facility on the north side of the Tokay Canal to reduce peak flows entering the canal.
Benefits:	Although this project does not have a significant impact on the Mill Street drainageway flooding, it does provide relief for the spill points along Foothills Boulevard, Elida Drive and Beacon Street.
Technical Data:	Peak 25-year runoff entering pond is 50 cfs. Peak 25-year runoff leaving pond is 20 cfs. Approx. storage volume: 5.0 ac-ft
Implementation Issues:	Probable land acquisition. Potential to impact the adjacent canal depending on design and configuration.
Capital Cost:	$ 344,031

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

S-15	Discussion
Problem Location:	The existing culvert crossing of the Southern Oregon and Pacific Railroad on Skunk Creek
Problem Summary:	Ponding and localized flooding is predicted upstream of the railroad culvert.
Alternative 1:	Install new 48” culverts beneath the railroad, resulting in three (3) total culverts.
Benefits:	Solves ponding and flooding problems upstream in Skunk Creek.
Technical Data:	Peak 25-year flow is 332 cfs.
Implementation Issues:	In-stream permitting required. May require specialized construction methods beneath the railroad (jacking and boring).
Capital Cost:	$ 638,868

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

R-1	Discussion
Problem Location:	The south end of Shannon Lane at the Rogue River
Problem Summary:	No water quality treatment is being provided for the contributing residential and industrial areas prior to discharging into the Rogue River.
Alternative 1:	Construct a proprietary water quality manhole.
Benefits:	Provides water quality treatment and reduces pollutant loads entering the Rogue River
Technical Data:	Peak water quality flow is 7 cfs.
Implementation Issues:	Possible utility relocations. Possible short-term closures of Shannon Lane.
Capital Cost:	$ 92,531

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

R-2	Discussion
Problem Location:	The south end of Herrick Court at the Rogue River
Problem Summary:	No water quality treatment is being provided for the contributing residential and industrial areas prior to discharging into the Rogue River.
Alternative 1:	Construct a proprietary water quality manhole.
Benefits:	Provides water quality treatment and reduces pollutant loads entering the Rogue River
Technical Data:	Peak water quality flow is 1.6 cfs.
Implementation Issues:	Possible utility relocations. Possible short-term closures of Herrick Court.
Capital Cost:	$ 66,134

TABLE 8.2-5
Alternatives Analysis Summary
Grants Pass: Skunk Creek Basin

R-3	Discussion
Problem Location:	The south end of Rogue Drive at the Rogue River
Problem Summary:	No water quality treatment is being provided for the contributing residential and industrial areas prior to discharging into the Rogue River.
Alternative 1:	Construct a proprietary water quality manhole.
Benefits:	• Provides water quality treatment and reduces pollutant loads entering the Rogue River
Technical Data:	Peak water quality flow is 30 cfs.
Implementation Issues:	Large water quality flow may require multiple proprietary units constructed in parallel. Possible utility relocations. Possible short-term closures of Rogue Drive.
Capital Cost:	$ 140,044

8.2.5 GPID Irrigation Canals

Recommended improvements for the irrigation canal within the UGB have been developed to address both specific and known problems as well as the overall limited capacity of the system. The site specific improvements such as SA-4 and S-14 were presented in the previous sections. The remaining system-wide problems require more of a programmatic solution to protect against wide-spread flooding during a large storm event. This solution needs to not only address the limited capacity of the canals but it also needs to address operation and maintenance. For the South Main, South Highline and the Tokay Canals, the capacity of the canals needs to be increased to accommodate all of the contributing upland runoff during the 25-yr event. The tables below provide general size recommendations for each canals.

In terms of operation and maintenance, the City and GPID will need to coordinate efforts to remove vegetation and debris, fix leaks and bank failures and maintain and operate the control structures and spillpoints. Given the interconnected nature of the systems, a joint agreement should be considered for these activities.

In addition, where at all possible, future developments within the UGB should not use the irrigation canal system as a point of discharge. If this is not a viable option, then the construction and maintenance of detention and water quality facilities will be essential to ensure any current canal flooding problems are not exacerbated.

TABLE 8.2-6
Alternatives Analysis Summary
Grants Pass: GPID Canal Improvements

C-1	Discussion
Problem Location:	The South Highline Canal
Problem Summary:	Localized flooding is predicted at various locations along the canal due to insufficient capacity.
Alternative 1:	Widen and line the existing canal to increase its conveyance capacity and reduce maintenance issues effecting conveyance.
Benefits:	• Reduces flooding along the canal by providing additional capacity.
Technical Data:	Peak 25-year flow: Approximately 175 cfs. Suggested channel geometry: Trapezoidal section with a 10’ bottom width, 3:1 side slopes and 3 foot minimum depth with a minimum slope of 0.068%. This is approximately 5 feet wider than the existing canal and 1 foot deeper.
Implementation Issues:	Possible land acquisition depending on existing irrigation easements.
Capital Cost:	None developed

TABLE 8.2-6
Alternatives Analysis Summary
Grants Pass: GPID Canal Improvements

C-2	Discussion
Problem Location:	The South Main Canal
Problem Summary:	Localized flooding is predicted at various locations along the canal due to insufficient capacity.
Alternative 1:	Widen and line the existing canal to increase its conveyance capacity
Benefits:	• Reduces flooding along the canal by providing additional capacity.
Technical Data:	Peak 25-year flow: Approximately 148 cfs. Suggested channel geometry: Trapezoidal section with a 10' bottom width, 3:1 side slopes and 2.75 foot minimum depth with a minimum slope of 0.068%. This is approximately 5 feet wider than the existing canal and 0.75 feet deeper.
Implementation Issues:	Possible land acquisition depending on existing irrigation easements.
Capital Cost:	None developed

TABLE 8.2-6
Alternatives Analysis Summary
Grants Pass: GPID Canal Improvements

C-3	Discussion
Problem Location:	The Tokay Canal
Problem Summary:	Localized flooding is predicted at various locations along the canal due to insufficient capacity.
Alternative 1:	Widen and line the existing canal to increase its conveyance capacity
Benefits:	• Reduces flooding along the canal by providing additional capacity.
Technical Data:	Peak 25-year flow: Approximately 220 cfs. Suggested channel geometry: Trapezoidal section with a 10' bottom width, 3:1 side slopes and 4.0 foot minimum depth with a minimum slope of 0.08%. This is approximately 8 feet wider than the existing canal.
Implementation Issues:	Possible land acquisition depending on existing irrigation easements.
Capital Cost:	None developed

SECTION 9

Capital Improvement Program

The goal of this master plan is to give the City a tool to proactively address existing and future stormwater capacity and water quality issues within the basin. With this in mind, the master plan was developed to identify infrastructure requirements for the collection, conveyance and treatment of stormwater runoff from the city and surrounding Urban Growth Boundary (UGB) now, and in the future, as the city urbanizes. The analyses performed in the development of the master plan expanded and built upon the existing drainage infrastructure, but also relied upon the use of low impact development practices to reduce on-site runoff and pollutant loadings. For all significantly redeveloped areas and new developments, a 30% reduction in impervious area was assumed to represent low impact development practices.

The stormwater system analysis identified and evaluated 62 individual projects within the six drainage basins. The CIP projects are divided into the following general improvement categories:

- ***Storm drain improvements*** including pipe replacement/up-sizing and hydraulically parallel pipes for increased conveyance
- ***Open channel and culvert improvements*** including culvert replacements and channel conveyance improvements to reduce flooding risk to surrounding structures or roadways.
- ***Detention improvements*** for reducing peak runoff rates within the basin thereby reducing the need for more costly storm drain improvements.
- ***Water quality improvements*** including water quality ponds and structural pollution reduction facilities (PRF) for reducing target pollutant concentrations and loads throughout the basin.
- ***Canal improvements*** including increasing conveyance capacity though enlargement or lining, bypasses and in-line detention facilities.

In addition to the 60 previously noted system improvements, the following low impact development practices were considered appropriate for new development within the city. Further discussion of each method are provided in Appendix D as a Best Management Practices (BMP) Toolbox.

- Vegetated swale
- Vegetative Filter Strips
- Stormwater treatment wetlands
- Planter Box/Sand Filters

- Dry Detention Pond
- Underground Detention
- Drywell
- Infiltration Pond/ Vegetated Infiltration Basin
- Pervious pavement
- Green streets
- Riparian corridor protection (land acquisition, stream buffers, etc.).

9.1 Cost Estimating

Cost estimates were developed for each CIP project and are summarized in Tables 9.2-1 though 9.2-5. CIP costs are considered order-of-magnitude estimates; that is they have an anticipated level of accuracy of +50% to -30%. The estimates include capital construction, construction management, engineering, permitting, as well as project land acquisition and mitigation costs. The cost estimates also include a 30% contingency, a 6% allowance for mobilization, 10% for insurance and bonding and 15% for utility relocations if the CIP is in an existing public right-of-way. All unit costs factors were obtained from recent data, including ODOT bid tabs (2003-2004), equipment suppliers, communication with City staff and *Site Work and Landscape Cost Data, RS Means*. All estimates are in 2005 dollars.

9.2 Recommended Plan Summary

This section summarizes the recommendation for each basin by project ID and along with a description of project improvement category and estimated capital costs.

9.2.1 Sand Creek Basin

The recommended plan includes 15 individual CIP projects, which are summarized in Table 9.2-1 and graphically in Figure 9.2-1. Collectively, the improvements include three new detention/water quality ponds, one retrofitted water quality pond, three structural pollution reduction facilities, three new culverts, and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over seven millions dollars, which includes all construction activities, mitigation and land acquisition, with the exception of mitigation land acquisition and maintenance. (Included in appendix C of this report are detailed cost breakdowns for each improvement.) Land acquisition needs primarily focus around the detention/water quality ponds (SA-2, SA-6 and SA-10) and total roughly 3 acres of residentially zoned property. Additional permitting and mitigation may also be required for these areas as they are potentially wetlands. From an implementation standpoint, a majority of the projects are located in public right-of-way, although in several cases, coordination with the County and ODOT may be required. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

TABLE 9.2-1
Cost Summary of Recommended Improvements
Grants Pass: Sand Creek Basin

ID	Improvement Category	Capitol Cost ($)
SA-1	• Water quality improvement	$ 332,146
SA-2	• Storm drain improvement • Detention improvement • Open channel improvement • Water quality improvement	$ 1,533,772
SA-2A	• Storm drain improvement	$ 164,599
SA-3	• Open channel improvement • Storm drain improvement	$ 335,448
SA-4	• Storm drain improvement	$ 1,171,856
SA-4A	• Water quality improvement	$ 140,044
SA-5	• Storm drain improvement	$ 107,822
SA-5A	• Water quality improvement	$ 226,494
SA-6	• Detention improvement • Water quality improvement	$ 397,665
SA-7	• Culvert improvement • Open channel improvement	$ 179,502
SA-8	• Storm drain improvement • Water quality improvement	$ 1,329,529
SA-9	• Culvert improvement	$ 216,956
SA-10	• Storm drain improvement • Detention improvement • Open channel improvement • Water quality improvement	$ 847,465
SA-11	• Culvert improvement	$ 118,367
SA-12	• Culvert improvement	$ 144,048
	Total	**$ 7,245,713**

9.2.2 Gilbert Creek Basin

The recommended plan for the Gilbert Creek basin includes 23 individual CIP projects, which are summarized in Table 9.2-2 and graphically in Figure 9.2-2. Collectively, the improvements include one large regional detention/water quality facility, two smaller detention/water quality ponds, seven structural pollution reduction facilities, one channel capacity expansion project, and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just under 13.0 millions dollars, which includes all construction activities, mitigation and land acquisition. Land acquisition needs primarily focus around the detention/water quality ponds (G-11, G-14B and G-18) and total roughly 4.5 acres of residential and commercial zoned property. From an implementation standpoint, a majority of the projects are located in public right-of-way within the existing city, however a number of new projects are also proposed in the hilly areas surrounding the Blue Gulch area. Additional erosion control will be required for these projects. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

TABLE 9.2-2
Cost Summary of Recommended Improvements
Grants Pass: Gilbert Creek Basin

ID	Improvement Category	Capitol Cost ($)
G-1	• Storm drain improvement • Water quality improvement	$ 958,909
G-1A	• Water quality improvement	$ 89,694
G-2	• Water quality improvement	$ 137,207
G-3	• Water quality improvement	$ 112,922
G-4	• Culvert Improvement	$ 1,296,515
G-5	• Storm drain improvement	$ 969,566
G-6	• Storm drain improvement	$ 255,410
G-7	• Storm drain improvement	$ 195,322
G-8	• Storm drain improvement	$ 528,351
G-9	• Storm drain improvement	$ 372,953
G-10	• Water quality improvement • Storm drain improvement	$ 582,813
G-11	• Detention improvement • Water quality improvement	$ 297,427
G-12	• Storm drain improvement	$ 308,674
G-13	• Water quality improvement	$ 140,044

TABLE 9.2-2
Cost Summary of Recommended Improvements
Grants Pass: Gilbert Creek Basin

ID	Improvement Category	Capitol Cost ($)
G-14	• Storm drain improvement	$ 558,427
G-14A	• Storm drain improvement	$ 1,109,029
G-14B	• Detention improvement • Water quality improvement	$ 2,579,046
G-15	• Water quality improvement	$ 280,089
G-16	• Open channel improvement	$ 292,224
G-17	• Storm drain improvement	$ 276,079
G-17	• Storm drain improvement	$ 98,556
G-18	• Detention improvement • Water quality improvement	$ 1,392,674
G-19	• Storm drain improvement	$ 147,721
	Total	**$ 12,979,652**

9.2.2.1 Special Considerations: Blue Gulch Area

Given today's regulatory environment and the inherent water quality benefits of surface flow, it is recommended that the channel system within the Blue Gulch area remain open with minimal obstructions such as culvert crossings or exceedingly close development. Future upland developments that will drain to this channel are recommended to use the traditional pipe, pond, water quality BMP approach for stormwater treatment. Additionally, consideration should be given to sediment traps prior to discharge to the channel to reduce maintenance and keep the conveyance and treatment system functioning. Example BMPs specific to hillside development are provided in Appendix D of this report.

9.2.3 Allen Creek and Fruitdale Creek Basins

The recommended plan for the Allen Creek and Fruitdale Creek basins includes 12 individual CIP projects, which are summarized in Table 9.2-3 and graphically in Figure 9.2-3. Collectively, the improvements include two large regional detention facilities in the upper reaches of each basin, two culvert replacement projects, four structural pollution reduction facilities, one water quality pond, two water quality swales and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over nine millions dollars, which includes all construction activities and land acquisition. Land acquisition needs primarily focus around the regional detention facilities and the smaller water quality ponds (A-4, A-7, and F-7) and total roughly 6.3 acres of residential and commercial zoned property. Project A-3, which involves constructing a new storm drain system that discharges to an existing wetland, may require additional permitting and mitigation. From an implementation standpoint, several projects (A-1, A-2 and F-3) are located in along major roadways (Rogue River Highway, Redwood Highway and Williams Highway) and will likely require coordination with the County and ODOT. Additionally, because ODOT is currently investigating improvements to Redwood Highway, improvements A-1 and A-2 may be partially or fully funded and constructed by ODOT. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

TABLE 9.2-3
Cost Summary of Recommended Improvements
Grants Pass: Allen Creek and Fruitdale Creek Basins

ID	Improvement Category	Capitol Cost ($)
A-1	• Culvert improvement	$ 1,225,017
A-2	• Water quality improvement	$ 125,927
A-3	• Storm drain improvement • Water quality improvement	$ 297,382
A-4	• Storm drain improvement • Water quality improvement	$ 769,181
A-5	• Water quality improvement	$ 92,531
A-7	• Detention improvement • Water quality improvement	$ 1,795,778
F-1	• Water quality improvement	$ 226,660
F-3	• Storm drain improvement	$ 784,360
F-4	• Storm drain improvement	$ 410,603
F-5	• Water quality improvement	$ 238,578
F-6	• Culvert improvement	$ 328,314
F-7	• Detention improvement • Water quality improvement	$ 2,951,252
	Total	**$ 9,241,583**

9.2.3.1 Special Considerations: Irrigation Canals

In addition to the traditional conveyance and water quality improvements in the Allen and Fruitdale Creek basins, special consideration should be given to the irrigation canals that bisect the two basins. Localized flooding resulting from excessive stormwater runoff was predicted at various locations along both the South Main Canal and South Highline Canals. Specific improvements are needed for these areas because of their length and because they are likely to require special coordination with the Grants Pass Irrigation District as well as numerous neighboring land owners and possibly ODOT. In addition to these system-wide improvements, more rigorous maintenance of the canal system is recommended including cleaning, lining, and widening in areas that experience flooding.

9.2.4 Skunk Creek and Jones Creek Basins

The recommended plan for the Skunk Creek and Jones Creek basins includes 12 individual CIP projects, which are summarized in Table 9.2-4 and graphically in Figure 9.2-4. Collectively, the improvements include a series of major channel improvements to the Mill Creek drainageway; one detention facility, six structural pollution reduction facilities, one new culvert and several new and replaced storm drain pipe segments. The total capital cost for the improvements is just over five millions dollars, which includes all construction activities and land acquisition. Land acquisition needs primarily focus around the detention facility (S-14) and the Mill Street drainageway (S-5) and total roughly 0.5 acres of residential and commercial zoned property. From an implementation standpoint, improvements along Skunk Creek and the Mill Street drainageway will require coordination with surrounding property owners and businesses as well as the Southern Oregon & Pacific Railroad. Other implementation issues that will be encountered include roadway closures and/or temporary traffic control, utility conflicts and in some cases, significant excavation depths and quantities.

TABLE 9.2-4
Cost Summary of Recommended Improvements
Grants Pass: Skunk Creek and Jones Creek Basins

ID	Improvement Category	Capitol Cost ($)
S-1	• Storm drain improvement	$ 544,776
S-2	• Storm drain improvement	$ 136,322
S-3	• Storm drain improvement • Open channel improvement • Water quality improvement	$ 378,626
S-5	• Open channel improvement • Storm drain improvement • Culvert improvement	$ 318,812
S-10	• Storm drain improvement • Water quality improvement	$ 664,891
S-11	• Storm drain improvement • Water quality improvement	$ 411,379
S-12	• Storm drain improvement	$ 1,274,144
S-14	• Detention improvement • Canal improvement	$ 344,031
S-15	• Culvert improvement	$ 638,868
R-1	• Water quality improvement	$ 92,531

TABLE 9.2-4
Cost Summary of Recommended Improvements
Grants Pass: Skunk Creek and Jones Creek Basins

ID	Improvement Category		Capitol Cost ($)
R-2	• Water quality improvement		$ 66,134
R-3	• Water quality improvement		$ 140,044
		Total	**$ 5,020,558**

9.2.4.1 Special Considerations: Irrigation Canals

In addition to the localized conveyance improvements identified in the Skunk Creek basin, special consideration should be given to the Mill Street drainageway that collects and conveys nearly 70% of the Skunk Creek Basin. Localized flooding was predicted within the channel itself and backwater from the channel created flooding in connecting storm drain systems. Given the relatively long length of the channel reach, the number of undersized culvert crossings and the physical constraints of the surrounding properties, individual improvements are not being recommended for this area. Rather, improvements to the channel system as a whole are provided to lessen both flooding in the immediate areas around the channel and also the contributing upstream drainage basins. Lastly, initiating or improving a systematic channel maintenance program is strongly recommended to alleviate current flooding prior to the complete implementation of the channel reach improvements. This maintenance plan should include removal of invasive species, routine clearing of sediment and debris at the culvert inlet and outlet locations following large storm events.

9.3 Implementation Plan

The recommended stormwater improvements for the City of Grants Pass are prioritized according to a point-based implementation matrix basin-by-basin as well as city-wide. This matrix, which was completed by the project team and City staff, includes weightings for cost, safety/liability, complexity, impact, environmental benefit, and whether the project is addressing a known problem.

9.3.1 Project Prioritization

The process of prioritizing the order of the recommended CIP projects included developing a point-based implementation matrix, entering appropriate project-specific data and evaluating the prioritization results. This point-based matrix evaluation was used along with criteria relevant to the issues and problems present in the existing storm drain system so that a sound implementation priority could be established. The project evaluation criteria and their definitions are summarized below.

- **Cost.** Total estimated cost of CIP.
- **Safety/Liability.** What potential safety and/or liability issues are involved?
- **Complexity.** How quickly can the solution be implemented and with what level of effort?
- **Impacts.** How large an area and/or how many properties does the problem impact?
- **Environmental Benefit.** Are there direct environmental benefits associated with the project (e.g., water quality, fish or habitat improvement)?
- **Known Problem.** Is the improvement addressing a known stormwater problem area?

The process also weighted the evaluation criteria using a scoring definition that assigned points based on the application of the criteria. Scores of 1, 5 or 10 were assigned to each criteria based on the score definitions shown in Table 9.3-1.

TABLE 9.3-1
Summary of CIP Scoring Definition
Grants Pass: Sand Creek Basin

Criteria	10 Points	5 Points	1 Point
Cost	< $100,000	> $100,000 & < $1,000,000	> $1,000,000
Safety/Liability	No Hazard	Moderate Hazard	Significant Hazard
Complexity	May be performed by small crew in less than a month	Typical (moderate) level of design and implementation	Requires significant design, contract documents or complex construction
Impacts	Has region-wide effects	Affects small sub-basin	Affects only 1 or 2 individual properties
Environmental Benefit	Significantly improves water quality or habitat	Moderately improves water quality or habitat	No environmental benefit
Known Problem	Reoccurring problem	Occasional problem	No known problem

9.3.1.1 Basin CIP Summary

The CIP project with the highest rating (e.g., most number of points) is the highest priority project with sequentially lower priority given to projects with fewer points. Projects were also classified as large (greater than $500,000) and small (less than $500,000) and short- and long-term CIP projects (short-term CIP projects are anticipated to occur in the next 5 years). The results of the prioritization for each basin are shown in Tables 9.3-2 through 9.3-9.

TABLE 9.3-2
CIP Scoring Summary
Grants Pass: Sand Creek Basin

ID	Cost	Safety/ Liability	Complexity	Impact	Env. Benefit	Known Problem	Total	Size
Weight	**0.2**	**1**	**0.5**	**1**	**0.7**	**0.3**		
SA-1	5	5	5	5	10	5	22	S
SA-2	1	5	1	5	10	1	18	L
SA-2A	5	5	10	5	1	1	17	S
SA-3	5	5	5	5	1	10	17.2	S
SA-4	1	5	1	10	1	10	19.4	L
SA-4A	5	1	5	1	10	1	12.8	S
SA-5	5	5	5	1	1	1	10.5	S
SA-5A	5	1	5	1	10	1	12.8	S
SA-6	5	5	5	5	5	10	20	S
SA-7	5	5	5	5	5	10	20	S
SA-8	1	5	1	5	5	10	17.2	L
SA-9	5	5	5	1	1	1	10.5	S
SA-10	5	5	1	10	5	5	21.5	L
SA-11	5	5	5	1	1	1	10.5	S
SA-12	5	5	5	1	1	10	13.2	S

“t” rank indicates a tie

TABLE 9.3-3
Recommended Plan
Grants Pass: Sand Creek Basin

	ID	Rank	Cost	0-5 yr CIP	Long-term CIP
Large	SA-10	1	$ 847,465	×	
	SA-4	2	$ 1,171,856		×
	SA-2	3	$ 1,533,772		×
	SA-8	4	$ 1,329,529		×
Small	SA-1	1	$ 332,146	×	
	SA-6	2t	$ 397,665	×	
	SA-7	2t	$ 179,502	×	
	SA-3	4	$ 335,448		×
	SA-2A	5	$ 164,599		×
	SA-12	6t	$ 144,048		×
	SA-4A	7t	$ 140,044		×
	SA-5A	7t	$ 226,494		×
	SA-5	9t	$ 107,822		×
	SA-9	9t	$ 216,956		×
	SA-11	9t	$ 118,367		×

“t” rank indicates a tie

TABLE 9.3-4
CIP Scoring Summary
Grants Pass: Gilbert Creek Basin

ID	Cost	Safety/ Liability	Complexity	Impact	Env. Benefit	Known Problem	Total	Size
Weight	**0.2**	**1**	**0.5**	**1**	**0.7**	**0.3**		
G-1	5	5	1	5	5	1	15.3	L
G-1A	10	1	5	1	10	5	15	S
G-2	5	1	5	1	10	5	14	S
G-3	5	1	5	1	10	5	14	S
G-4	1	10	5	5	1	10	21.4	L
G-5	5	5	1	5	1	5	13.7	L
G-6	5	5	10	5	1	1	17	S
G-7	5	5	10	5	1	1	17	S
G-8	5	5	5	5	1	1	14.5	L
G-9	5	5	5	5	1	5	15.7	S
G-10	5	1	1	10	10	10	22.5	L
G-11	5	10	5	1	5	10	21	S
G-12	5	5	5	5	1	1	14.5	S
G-13	5	1	5	1	10	5	14	S
G-14	5	5	5	5	1	10	17.2	L
G-14A	1	5	1	5	5	5	15.7	L
G-14B	1	5	1	10	5	1	19.5	L
G-15	5	1	5	1	10	5	14	S
G-16	5	10	5	5	1	10	22.2	S
G-17	5	5	5	5	1	1	14.5	S
G-17A	10	5	10	1	1	5	15.2	S
G-18	1	10	1	10	10	10	30.7	L
G-19	5	5	5	5	1	1	14.5	S

“t” rank indicates a tie

TABLE 9.3-5
Recommended Plan
Grants Pass: Gilbert Creek Basin

	ID	Rank	Cost	0-5 yr CIP	Long-term CIP
Large	G-18	1	$ 1,392,674	×	
	G-10	2	$ 582,813	×	
	G-4	3	$ 1,296,515		×
	G-14B	4	$ 2,579,046		×
	G-14	5	$ 558,427		×
	G-14A	6	$ 1,109,029		×
	G-1	7	$ 958,909		×
	G-8	8	$ 528,351		×
	G-5	9	$ 969,566		×
Small	G-16	1	$ 292,224	×	
	G-11	2	$ 297,427	×	×
	G-6	3	$ 255,410		×
	G-7	3	$ 195,322		×
	G-9	5	$ 372,953		×
	G-17A	6	$ 98,556		×
	G-1A	7	$ 89,694		×
	G-12	8	$ 308,674		×
	G-17	8	$ 276,079		×
	G-19	8	$ 147,721		×
	G-2	12	$ 137,207		×
	G-3	12	$ 112,922		×
	G-13	12	$ 140,044		×
	G-15	12	$ 280,089		×

"t" rank indicates a tie

TABLE 9.3-6
CIP Scoring Summary
Grants Pass: Allen Creek and Fruitdale Creek Basins

ID	Cost	Safety/ Liability	Complexity	Impact	Env. Benefit	Known Problem	Total	Size
Weight	**0.2**	**1**	**0.5**	**1**	**0.7**	**0.3**		
A-1	1	1	1	5	5	5	11.7	L
A-2	5	1	5	5	10	1	16.8	S
A-3	5	5	5	5	5	1	17.3	S
A-4	5	1	5	5	5	1	13.3	L
A-5	10	1	5	1	10	1	13.8	S
A-7	1	5	1	10	5	5	20.7	L
F-1	5	1	5	1	10	1	12.8	S
F-3	5	5	1	5	1	1	12.5	L
F-4	5	5	5	5	1	10	17.2	S
F-5	5	1	5	1	10	1	12.8	S
F-6	5	10	5	5	5	10	25	S
F-7	1	5	1	10	5	5	20.7	L

“t” rank indicates a tie

TABLE 9.3-7
Recommended Plan
Grants Pass: Allen Creek and Fruitdale Creek Basins

	ID	Rank	Cost	0-5 yr CIP	Long-term CIP
Large	**A-7**	1t	$ 1,795,778		×
	F-7	1t	$ 2,951,252		×
	A-4	3	$ 769,181		×
	F-3	4	$ 784,360		×
	A-1	5	$ 1,225,017		×
Small	**F-6**	1	$ 328,314	×	
	A-3	2	$ 297,382		×
	F-4	3	$ 410,603		×
	A-2	4	$ 125,927		×
	A-5	5	$ 92,531		×
	F-1	6t	$ 222,660		×
	F-5	6t	$ 238,578		×

"t" rank indicates a tie

TABLE 9.3-8
CIP Scoring Summary
Grants Pass: Skunk Creek and Jones Creek Basins

ID	Cost	Safety/ Liability	Complexity	Impact	Env. Benefit	Known Problem	Total	Size
Weight`	**0.2**	**1**	**0.5**	**1**	**0.7**	**0.3**		
S-1	5	5	5	5	1	1	14.5	L
S-2	5	5	10	1	1	1	13	S
S-3	5	5	5	5	5	5	18.5	S
S-5	5	10	5	10	5	10	30	S
S-10	5	5	5	5	5	1	17.3	L
S-11	5	5	5	5	5	1	17.3	S
S-12	1	5	1	5	1	5	12.9	L
S-14	5	5	5	5	1	5	15.7	S
S-15	5	5	1	1	1	5	9.7	L
R-1	10	1	5	1	10	1	13.8	S
R-2	10	1	5	1	10	1	13.8	S
R-3	5	1	5	1	10	1	12.8	S

“t” rank indicates a tie

TABLE 9.3-9
Recommended Plan
Grants Pass: Skunk Creek and Jones Creek Basins

	ID	Rank	Cost	0-5 yr CIP	Long-term CIP
Large	**S-10**	1	$ 664,891		×
	S-1	2	$ 554,776		×
	S-12	3	$ 1,274,144		×
	S-15	4	$ 638,868		×
Small	**S-5**	1	$ 318,812	×	
	S-3	2	$ 378,626	×	
	S-11	3	$ 411,379		×
	S-14	4	$ 344,031		x
	R-1	5	$ 92,531		×
	R-2	5	$ 66,134		×
	S-2	7	$ 136,322		×
	R-3	8	$ 140,044		×

"t" rank indicates a tie

9.3.1.2 City-Wide CIP Summary

The large and small CIP projects with the highest city-wide rating are presented below in Table 9.3-10. The purpose of this summary is to highlight the projects that are most beneficial to the city, regardless of basin.

TABLE 9.3-10
City-Wide Recommended Plan
Grants Pass: SWFMP

	ID	Rank	Cost	0-5 yr CIP	Long-term CIP
Large	**G-18**	1	$ 1,392,674	×	
	G-10	2	$ 582,813	×	
	SA-10	3	$ 847,465	×	
		Subtotal	**$ 2,822,952**		
	Other	4-22			×
		Total	**$ 25,516,219**		
Small	**S-5**	1	$ 318,812	×	
	F-6	2	$ 328,314	×	
	G-16	3	$ 292,224	×	
	SA-1	4	$ 332,146	×	
	G-11	5	$ 297,427	×	
	SA-6	6t	$ 379,665	×	
	SA-7	6t	$ 179,502	×	
	S-3	8	$ 378,626	×	
		Subtotal	**$ 2,506,716**		
	Other	9-40			×
		Total	**$ 8,971,287**		
		Total	**$ 34,487,506**		

Collectively, the 3 highest priority large projects are anticipated to cost just under 3 million dollars. Additionally, the 8 highest priority small projects are anticipated to cost roughly 2.5 million dollars, with at least one high priority CIP project located in each of the drainage basins.

SECTION 10

References

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Appendix A: Model Network and Mapping

Appendix B: Tabular Results

Appendix C: Detailed Cost Estimates

Appendix D: BMP Toolbox

Appendix E: Storm Drain Survey Forms

Appendix F: Storm Drain Maintenance Recommendations

Proper maintenance of the city's storm drainage system is as essential as an adequately sized system if storm flows are to be properly conveyed and treated prior to discharge to the creek system or Rogue River. This master plan presents general recommendations maintaining the city's storm drain system, open channel and creek reaches and proposed water quality detention facilities.

Recommended storm drain maintenance practices and frequencies are shown in Table F-1. These may differ in practice based on design features, local conditions and other factors.

TABLE F-1
Recommended Maintenance Practices: Proprietary Pollution Reduction Facilities
Grants Pass: SWFMP

Maintenance Practice	Recommended Frequency
Inspections	Quarterly (in winter months)
Sediment Removal	Annually or when sediment depth is greater than 50% of available storage volume
Debris Management	Quarterly inspection or on discovery

Maintenance of the open channel portions of the city's storm drain system (ditches, swales, creeks, etc) is essential to ensure continued conveyance capacity and flood protection. The major creeks and channels should be visited on a bi-annual basis (at a minimum), as well as following high flow events to monitor for bank failures, debris accumulation and excessive vegetation. Large accumulations of debris should be noted during inspection. If the debris poses a threat to channel stability or flooding, it should be removed. It is also recommended that stream reaches be inspected to ensure that invasive species are managed.

Recommended structure pollution control facility maintenance practices and frequencies are shown in Table F-2. These may differ in practice based on design features, local conditions and other factors.

TABLE F-2
Recommended Maintenance Practices: Structural Pollution Reduction Facilities
Grants Pass: SWFMP

Maintenance Practice	Recommended Frequency
Inspections	Quarterly (in winter months)
Sediment Removal	Annually or when sediment depth is greater than 50% of available storage volume
Debris Management	Quarterly inspection or on discovery

Recommended swale maintenance practices and frequencies are shown in Table F-3. These may differ in practice based on design features, local conditions and other factors.

TABLE F-3
Recommended Maintenance Practices: Water Quality Swales
Grants Pass: SWFMP

Maintenance Practice	Recommended Frequency
Mowing & Litter Pick-up	Minimum three times annually
Leaf Pick-up	Annually as needed
Reseeding	Annually
Swale Side Slope Repair	As needed
Check Dam Repair	As needed
Tilling Swale Bottom	As needed

Recommended regional detention facility maintenance practices and frequencies are shown in Table F-4. These may differ in practice based on design features, local conditions and other factors.

TABLE F-4
Recommended Maintenance Practices: Existing Regional Detention Facilities
Grants Pass: SWFMP

Maintenance Practice	Recommended Frequency
Inspections	Annually
Embankment: Stabilize and repair structural deficiencies	Periodically, as needed
Forebay Sediment Removal	5-year cycle or when sediment depth is greater than 50% of design capacity
Debris Management	Quarterly inspection or on discovery
Mulch replenishment	As needed, at least annually
Vegetation pruning or removal	When interferes with operations
Fallen leaves & debris	Annually
Removal of nuisance vegetation & replanting	When invasive vegetation constitutes up to 25% of area

Appendix G: Model Results Figures

Appendix H: Known Problem Areas

Appendix I: Surface Conveyance Map